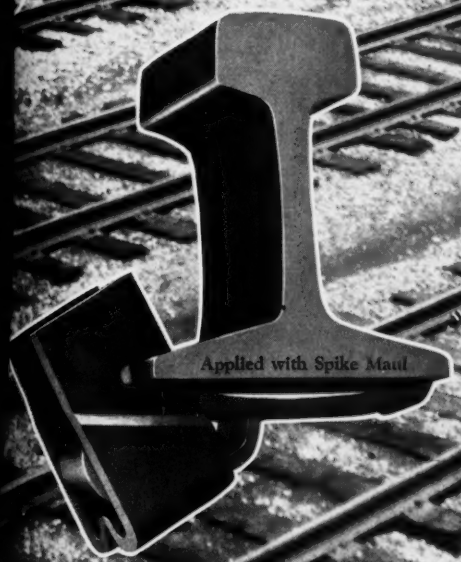
August, 1932

Railway Engineering and Maintenance



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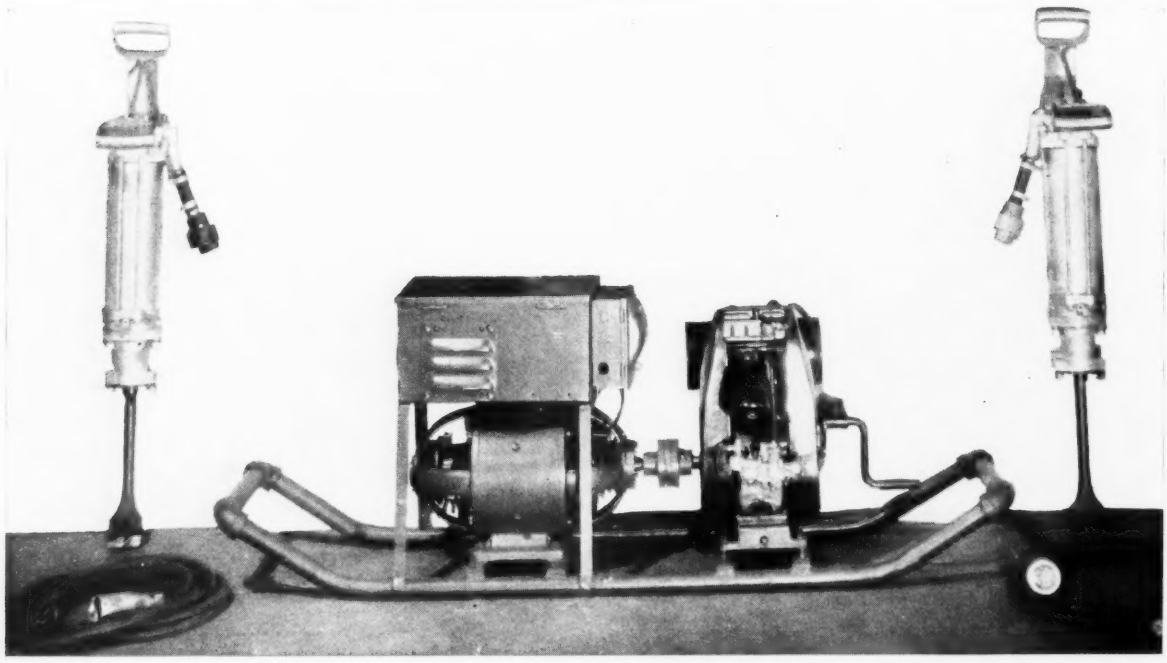

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RAILWAY ENGINEERING AND MAINTENANCE
Published monthly by Simmons-Boardman Publishing Co., 2200 Port Washington Road, Milwaukee, Wisconsin. Entered as second class matter February 14, 1931, at the postoffice at Milwaukee, Wisconsin, under the Act of March 3, 1879.

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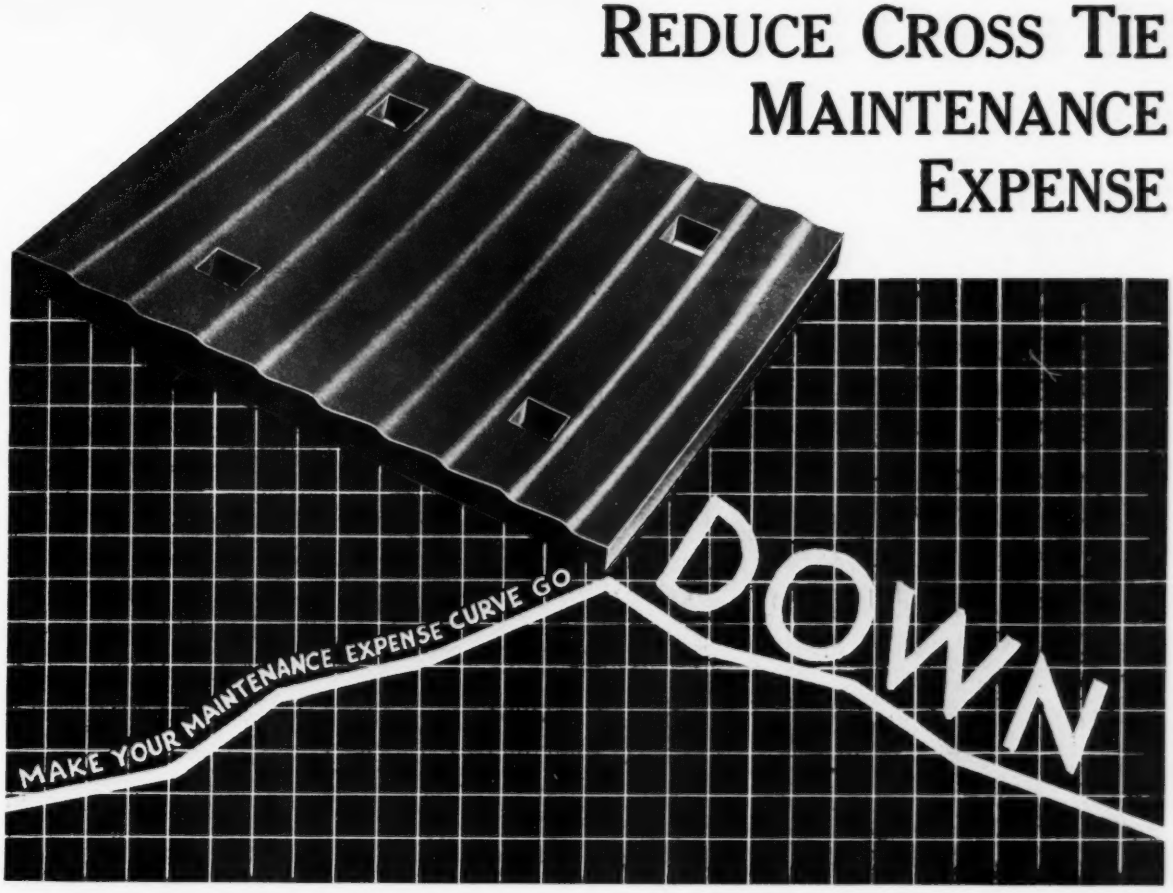
REDUCE CROSS TIE MAINTENANCE EXPENSE



Insure Maximum Tie Life and Minimum Tie Renewals

RAILROADS using Lundie Tie Plates are now reaping big benefits in the form of reduced tie renewals. These roads have a decided advantage during the present economic crisis—because they have reduced their annual tie renewals year after year to a point where they are now realizing worth-while savings in cross-tie maintenance expense.

The savings accruing from Lundie Tie Plates are cumulative. They get bigger and bigger each year as more Lundie Plates are placed in track and consequently tie-renewals become fewer and fewer. The tie-renewal curve and the tie-maintenance expense curve are definitely downward.

The Lundie Tie Plate gives superior service because it is more than just a tie plate—it is a tie protector. The complete elimination of sharp tie destroying projections protects ties against mechanical wear and assures 100 per cent service-life from treated ties. Millions in service prove this.

Low first cost and assured returns make this an economic device of the highest order.

The Lundie Engineering Corporation

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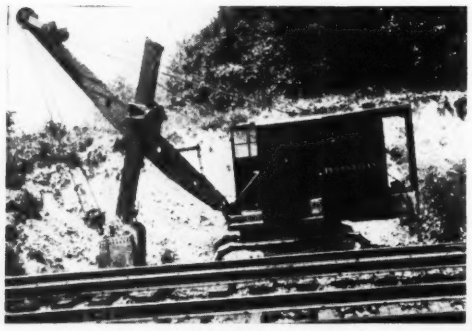
59 East Van Buren Street, Chicago

LUNDIE TIE PLATE

Save with a Bucyrus-Erie—

on the work trains—trimming banks—widening cuts—



handling aggregates—at 75 other jobs we can tell you about.

Tough Competition

—increases the need of your road for modern equipment — makes it all the more worth while to know Bucyrus-Erie design, performance, service, applications in your work.

Look into this most complete line—with its sound, responsible backing. Bucyrus-Erie Company, South Milwaukee, Wisconsin.

EXCAVATORS and CRANES

BUCYRUS ERIE *for every railroad need*

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THE BUCYRUS-ERIE LINE

Convertible Machines

Lifting cranes, shovels, draglines, clamshells

Sizes—½ to 2¼ yards

Powers — gasoline, Diesel, electric, gas + air, steam

Heavy Duty Shovels, Draglines

For stripping, quarry loading, heavy construction

Every size to 18 yards

Railway Cranes

200, 160 and 150 tons

Loadmaster

The utility crane

Spreader Plows

Dragline Buckets

A complete line — every size and weight

Light weight combined with strength

Winans' Mud Digger—1844

Before the days of alloys, strength in metals could be measured in terms of weight. Ross Winans' contribution to the development of the modern locomotive, built in 1844, weighed 23½ tons and pounded up so much dirt from the light track that it was called the "Mud Digger."

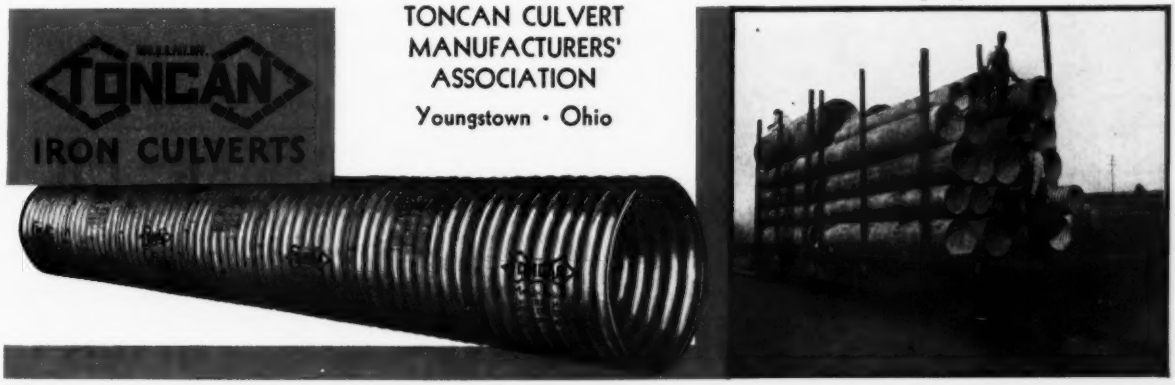
Metallurgical science has changed all this. Today, strength and light weight are combined by alloying metals unknown a few years ago.

Toncan Iron Culverts, made from an alloy of refined iron, copper and molybdenum, represent the ultimate in structural strength, light weight and resistance to corrosion. They stand up under heavy fills—cost less to transport—are easier to handle—cost less to install—last longer under the combined attack of those natural forces of soil, air and moisture which cause earlier failure of common ferrous metal culverts.

Railroads whose policy is to build well and whose buying is done with an eye to future economy should consider the savings that Toncan Iron Culverts will show.

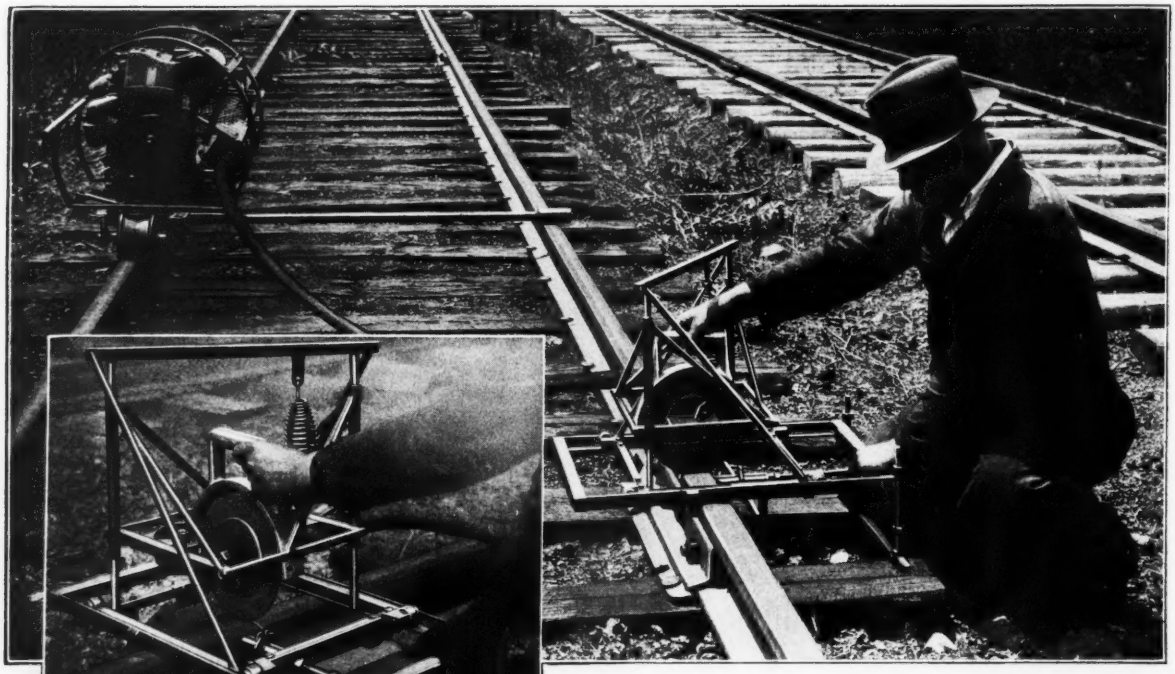
Ask for a copy of "Let's Get Down To Fundamentals." It will interest you.

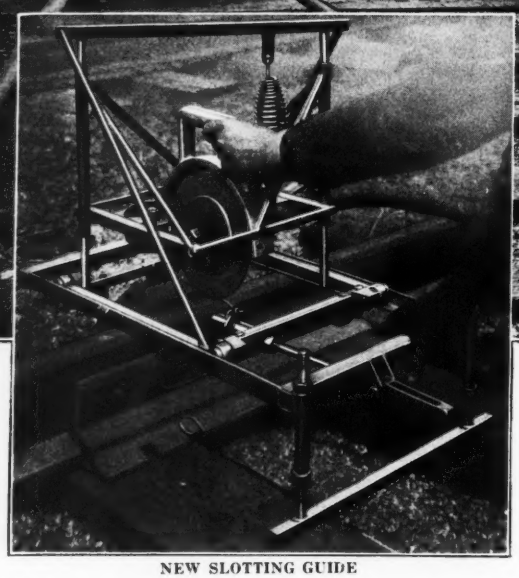
Loading a car of 24-inch and 48-inch Toncan Iron Culverts to be used at Long Beach, Cal. by the Union Pacific System.



TONCAN CULVERT MANUFACTURERS' ASSOCIATION

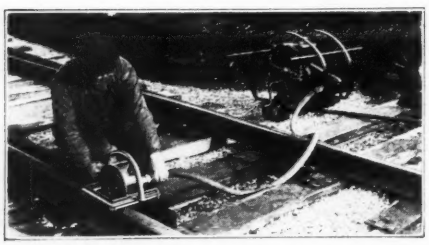
Youngstown · Ohio



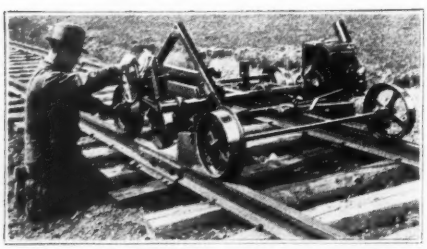


NEW SLOTTING GUIDE

Nordberg Cross Grinder equipped with slotting guide, grinds rail joints accurately and every slot is identical in shape. A valuable tool on every track betterment program.



Cross Grinder with cup wheel for switch maintenance. Invaluable to every Track Supervisor.



Nordberg Rail Grinder puts a perfect "top" on welded rail.

Machine Shop Precision Now Assured In Rail Slotting

With the new Slotting Guide for Nordberg Cross Grinders, perfect mechanical accuracy is assured—and grinding can be accomplished to any depth, without danger of the wheel being pinched and broken.

Rail and Cross Grinders, like other maintenance machinery developed by Nordberg, offer many advantages to those seeking improved track standards and lower maintenance expense. They are designed to meet the newer ideas in track work. **Accuracy, strength, light weight, ease of operation** and **durability** have been built into them.

If you are doing rail welding, slotting joints, or are interested in a better and cheaper way to maintain switches, you need these grinders. They are just as outstanding in their performance as the other track maintenance tools bearing the Nordberg name.

Write the Railway Equipment Department for more information on these grinders, or on the other machines that Nordberg developed for your track maintenance jobs.

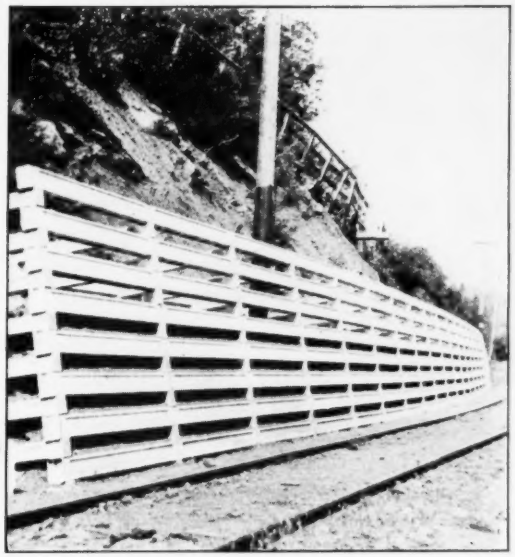
Railway Equipment Department

NORDBERG MFG. CO.,

MILWAUKEE, WIS.

NORDBERG MAINTENANCE MACHINERY

CONSIDER These Economy FEATURES of ARMCO METAL *Cribbing*



This new superior type of crib wall is designed particularly for railway retaining walls, bridge wingwalls, railway embankments, loading platforms and river and harbor bank protection work.

Lightness of weight (many times only 1/10 weight of older types of cribbing) results in low cost transportation. Special handling equipment or skilled labor are unnecessary. Construction time is materially reduced. One man can handle the units.

Metal gives these savings: There is no breakage in handling. It does not absorb water, spall or crack, nor does it pull apart or break in unstable soils. Pile or caisson sub-foundation is unnecessary in built-up ground.

100% Salvage Value. Armco Crib Walls may be dismantled and relocated without loss of a single unit. This feature makes them especially economical for emergency work. Height is easily increased by the addition of members.

Ask the Armco man to show you a copy of the Armco Cribbing Manual. Details of construction and other advantages are fully explained. Something every railroad official should see. Use the coupon.

ARMCO CULVERT MANUFACTURERS ASSOCIATION, Middletown, Ohio

Armco culverts and drains and cribbing are manufactured from the Armco Ingot Iron of The American Rolling Mill Company and always bear its brand.

Other Armco Drainage Products

Paved Invert Pipe • Perforated Metal Pipe
Part Circle Culverts • Multi-Plate Pipe
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☐ Send more data on Armco Metal Cribbing.
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I am interested in a crib wall approximately..... long by.....high.

Name .....
Title .....
Road .....
Address .....
City ..... State .....

No. 44 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY
105 WEST ADAMS ST.
CHICAGO, ILL.

July 28, 1932

Subject: A Day for Fighters

Dear Reader:

When on one of the mountain railways of Colorado a few years ago, my attention was directed to the fact that while the older and more experienced track foremen are entirely willing to take valley sections in the summer, when winter approaches they insist on their seniority rights to bid in the mountain sections. The task of keeping the line open above timber line and of fighting snow and ice for days and weeks at a time is no job for a tenderfoot, they contend, but requires men of experience and proven ability.

As I observe the conditions under which maintenance men are working today, and the remarkable manner in which they are keeping traffic moving in the face of such drastic curtailments in expenditures for upkeep, I cannot help but feel that, like the winter in the mountains, these are days that demand the best in men. It is required today that track be maintained with greatly curtailed forces, with limited material and yet withal, to the same high standards as during the prosperous days of 1929.

There is now much to discourage maintenance men. Yet these conditions bring out the same fighting spirit and determination that characterize mountain railroading. It is of such a spirit that real maintenance men are made. They love a fight. Today is their opportunity. This is no time for a tenderfoot.

Yours truly,

Elmer T. Howson

ETH*JC

Editor.

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

MOLES

Clean Ballast Without Obstructing Tracks

Mole Statistics

Average performance for 1931 of forty-three Intertrack Moles on four railroads, covering the widest possible range of operating conditions:

Average intertrack space cleaned per hour	**78.2 feet**
Average cleaning depth below top of tie	**17 inches**
***Average cost per foot** (all charges including annual overhauling, but not including interest or depreciation)	**4.6 cents**
***Average cost per cubic yard**	**25.5 cents**
Depreciation and interest per lineal foot cleaned (based on an average of twenty miles cleaned per season at 14%)	**1.2 cents**

***Note: Includes, in many cases, labor cribbing out ballast from rail to end of tie.**

One Mole, in the 1931 season, cleaned 50.64 miles of intertrack space. Seven Moles on one railroad averaged 36.2 miles.

RAILWAY MAINTENANCE CORPORATION

Pittsburgh, Pa.

ONLY A TWO PIECE RAIL ANCHOR

COMPENSATES FOR VARIANCE IN RAIL SIZES

The improved Ericson Rail Anchor is a two piece device and its superiority rests in that very fact.

The Ericson is adjustable and obviously, adjustability in any rail anchor is most desirable and essential.

It is well known to all engineers familiar with rail specifications, and especially mechanical tolerance, that a new rail base may vary as much as 1/16" under or over the theoretical width dimension and the rail base flanges also may vary in thickness.

It follows therefore that a two-piece anchor provided with a true tapered take-up is peculiarly adaptable to function with the highest degree of efficiency regardless of such variations.

ERICSON RAIL ANCHOR

INDUSTRIAL AND RAILROAD SUPPLY COMPANY

NATIONAL SALES REPRESENTATIVES

MANUFACTURED BY ILLINOIS MALLEABLE IRON CO.

310 SOUTH MICHIGAN AVE. CHICAGO

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

AUGUST, 1932

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NEW

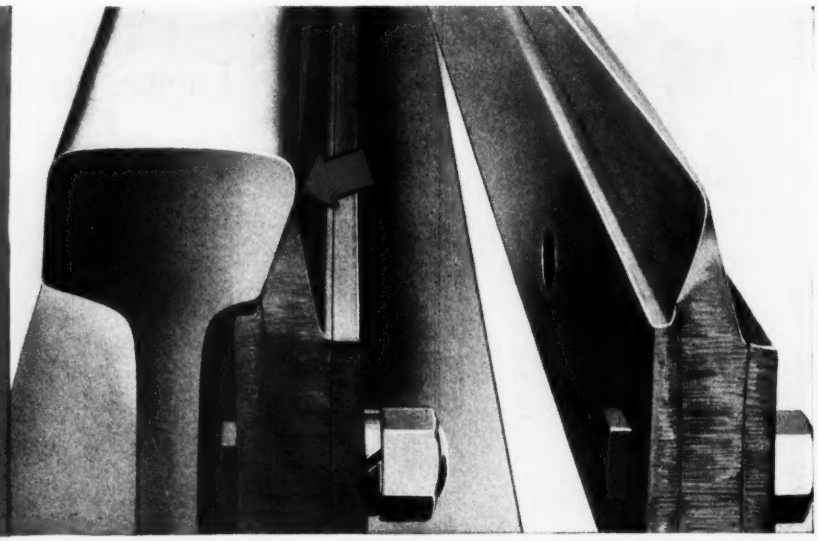

Fig. 1. *Photograph and view of Samson Switch Point.**

OLD

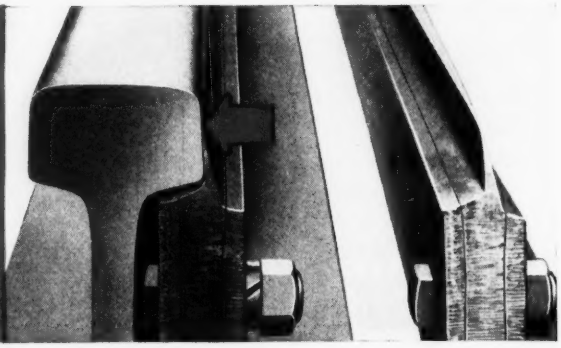

Fig. 2. *Photograph and view of Common Standard Knife-Blade Switch Point.*

THE RACOR SAMSON SWITCH POINTS*

with no extra cost . . .
assure remarkable economy and added safety

WHEN considering switch points take into account that the Racor Samson Switch* means no more short life of switch points . . . no more broken down switch points . . . no more need of switch point protectors.

Samson Switch Points maintain necessary wearing surfaces to engage wheel flanges for a smooth safe passage; with them there is no danger of wheel flanges mounting on jagged wearing surfaces; they give many times the life of common standard knife-blade switches. There is probably no recent innovation in trackwork that will give a greater return on investment than the Racor Samson Switch.*

Its remarkable length of life is assured by the inverted 'V' shape of the point that fits against the undercut stock rail as shown in Fig. 1 . . . It wears smoothly and WILL NOT BREAK DOWN.

Switch points, plates and rods cost no more than old standard equipment. The cost of the stock rails, machined as illustrated in Fig. 1, is negligible when compared to increased service life. Machined stock rails can be purchased with the switch; or, if preferred, they can be satisfactorily milled in the field with a portable milling machine, operated either electrically or pneumatically from air brake pressure cylinder.

Many large railroad systems in Continental Europe have adopted universally similar switch point planing. Also many large systems in the U.S.A. have installed the Samson Switch with proof of the above claims.

For further information write your nearest Ramapo plant or office.

*While covered by United States patents, all the larger manufacturers specializing in trackwork in this country have licenses to furnish the Samson Switch.

RACOR

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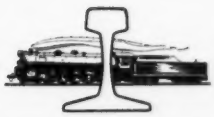
Railway Engineering and Maintenance



ACTION

Employees Awakening to Its Necessity

ONE of the most promising developments in recent months, from the standpoint of railway employees, is their awakening in so many localities to the seriousness of the threat against the future stability of the railways as sources of employment, as manifested by the organization of groups for united action in defense of their own interests. Starting with the spontaneous organization of "ship by rail" clubs in a number of railway centers, these groups have broadened their activities to include agitation for legislative protection of the railways against wildcat bus and truck competition, against public subsidy of competing transportation agencies and for the correction of other conditions that are seriously crippling the railways and causing great distress to them as employees. Within recent weeks these local groups have united into state organizations, notably in Virginia, Kentucky and Ohio, for still more aggressive action in defense of their interests.

This is a movement that has been sorely needed. All too long railway employees have left to their managements the solution of the problems of regulation, control of competition, etc., with the result that the public has come to look on these problems as of concern only to impersonal corporations of sufficient size to take care of their own interests, overlooking the fact that whatever affected these corporations adversely, affected the employees of these corporations just as adversely. Railway employees have only themselves to blame for this attitude. Now that they are awakening in so many areas to the necessity that they must themselves engage in the fight for the correction of the adverse conditions that are tending so directly to curtail employment today, relief will be greatly expedited. It will be hastened still more as the organization of these employees becomes more nearly universal and as the local units enroll those shopkeepers, professional men and other residents in their communities who are dependent on the welfare of railway employees for their livelihood and who share the attitude of the employees regarding these problems.

What Can These Organizations Do?

In launchng any movement of this kind, it is important that those who participate have an accurate understanding of the conditions that exist and of the measures that are needed to correct them in order that the activities of the organizations may be directed in those channels that will be most constructive and effective. To aid in this understanding, the following facts are presented:

1. The present crisis in the railway industry is due only in part to the depression in all business. Its difficulties are more deep seated; they were becoming evident even in the boom years of 1928 and 1929 and they will continue after the depression is lifted, unless corrected in the meantime.

2. The difficulties of the railways are not due to any inherent inefficiency in their operation, for never in their history were they operated so efficiently or served the public more adequately than in the years immediately preceding 1930. Measured by any of the commonly applied standards, the railways established new high records for service in this period.

3. Neither are the troubles of the railways the result of unwise financing. The federal valuation, although not yet completed and tested in the courts, and although challenged by the roads as unfairly low, refutes all charges of over-capitalization. Furthermore, between 1920 and 1930, the railways expended more than $6,000,000,000 for the improvement and enlargement of their properties; yet the increase in their outstanding capitalization in this period was less than $2,100,000,000, a record of conservatism in financing.

4. While the government is now aiding in maintaining the solvency of the railways through loans from the Reconstruction Finance Corporation, and while this aid is expected to be effective in preventing any considerable number of receiverships, this is but a temporary expedient. It does not correct the basic difficulties. Permanent relief will come only through the correction of fundamental conditions.

Rates Too Low

5. The most important condition contributing to the present situation is the failure of the Interstate Commerce Commission to permit the roads to so adjust rates as to enable them to earn the "fair return" promised in the Transportation Act of 1920. In no single year since the act became effective have the roads earned the return stipulated, while the deficiency since its passage exceeded $2,500,000,000 to the end of 1930.

6. The law under which the roads must operate makes no provision for their accumulation of a surplus during periods of good business to tide them over periods such as that through which we are now passing. As a result, unlike other industries, they have no reserves to draw from in times of subnormal earnings.

7. While the railways are themselves limited as to the rates they can charge, the service they must provide, the hours which they can work the employees, the wages which they must pay, etc., the government imposes no

such restrictions on competing agencies of transportation. They are free to operate where and when they desire, soliciting such traffic as they can handle with profit and ignoring other business, etc. Obviously, any competition between two agencies, only one of which is bound by any rules or regulations, cannot be other than unfair and in the end destructive.

8. Not only is the public requiring the railways to submit to unfair competition, but it is actually aiding and abetting this competition through subsidies in the form of federal appropriations for waterway development, federal and state construction of highways, excessive payments for air mail transportation, etc., without which aid relatively little of this competition could continue. Furthermore, in the case of the inland waterways at least, the government is itself engaged in transportation service in direct competition with the railways, with all of the unfairness that such a situation implies. Certainly the least that the railways have a right to expect and demand from the public is the thought expressed in the prayer of the colored boy—"Lord, if you won't help me, at least don't help the bear."

9. In every national emergency the country turns to the railways rather than to the buses and trucks or the barge lines for assistance. Whether it is to remove refugees from the flooded areas of the south or to transport feed and food supplies into the drought-stricken areas of the northwest, the railways are expected to rush to the rescue with special service, reduced rates, etc. Such positive evidence of the essential character of railway service in times of national emergency should not be cast aside lightly by the public at a time when other forms of transportation are threatening to undermine the very stability of this service.

These are the conditions which have contributed even more than the depression to the present railway situation—a situation that has forced them to reduce their purchases from the industries of this country from an average of about $2,000,000,000 annually to less than $600,000,000 now; that has caused them to lay off more than 700,000 employees and place many others on part time; that has reduced the annual payments to their employees from $3,000,000,000 to $1,700,000,000, and that in spite of these drastic retrenchments is resulting in failure to meet fixed charges to the amount of nearly $20,000,000 per month, a condition that would normally lead quickly to receiverships and that is now being prevented only by heavy borrowings from the Reconstruction Finance Corporation—indebtedness which must be repaid at an early date if government ownership is to be avoided.

The Remedies

So much for the conditions. It is equally important that the employees be familiar with the remedies that must be applied if the railways are to be restored to their normal status and are to aid in the general recovery of all business. Among the more important measures to this end are the following:

1. Withdrawal from the Interstate Commerce Commission and the state commissions of all power to regulate rates, except to correct and prevent unfair discrimination. In 1910, freedom to initiate rates was taken from railway officers by giving the Interstate Commerce Commission power to prevent proposed changes and that power has been more and more abused by the commission to restrict railway earnings in periods of prosperity until we are now confronted with the inevitably consequent railway financial debacle in a period of depression.

2. Application by appropriate legislation of the same prohibitions and penalties regarding unfair discriminations to all carriers by water and highway that are now applied to the railways, and requiring them to be enforced against all other carriers by the same authorities who now enforce them against the railways.

3. Withdrawal of every vestige of subsidy from all carriers by forcing them, through appropriate national and state legislation and administration, to pay sufficiently for the use of waterways and highways to relieve the public of all taxation now borne by it resulting from the use of public property for transportation for profit in competition with the railways. Neither in equity, law nor sound economics is any person or corporation entitled to use public property for private gain without compensating the public fully for such use.

4. Give to the railways by appropriate legislation the same rights to operate trucks and buses upon the highways and boats upon the waterways as are given to any other company.

5. Withdraw the federal government from the operation of its barge line upon the Mississippi river system.

6. Either apply to all industries comparable legislation regulating the relations between employers and employees, or repeal the Railway Labor Act and give railway managers the same freedom in dealing with employees as managers of other kinds of business have.

Employees Must Act

Such a program suggests a course of action for railway employees, individually and through the clubs which are now being organized so widely—first to acquaint those in their communities with the true situation and with the facts contributing to it, and secondly to enlist support and action for those measures which will correct these conditions. No one can do this work better than the million-odd employees of the railways, each in his own community. If every section and bridge and building foreman will undertake to cultivate a proper understanding of the situation in his own community, if every roadmaster, bridge supervisor and division engineer will co-operate with his foremen in launching such a movement and if these employees will then join with the employees of other departments and in other localities and with the citizens of their communities who are equally interested in the welfare of the railways, as the employees and citizens of two or three states have already done, a movement of such proportions will be initiated that will make its influence felt in the legislative halls of every state and in the national Congress in such a positive way that the handicaps under which the railways are now operating will be removed and their solvency restored, enabling them to re-employ hundreds of thousands of their men who are now out of work and will bring them back into the markets of the country in such a way as to give a real impetus to business.

No one has more at stake than railway employees and especially those in the maintenance of way department,

for it is in this department that the retrenchments have been most severe and the reductions in forces the heaviest. This is a time for action. We shall be glad to advise any employees how they can organize and mobilize their forces and put them in touch with those groups of railway employees who are already making their influence felt in no uncertain manner.

WELDING IN BRIDGES

Application to New Work Will Come Later

THE article on page 495 of this issue and also on page 444 of the July issue, which review the extended application of the electric welding process to the repair and reinforcing of metal bridges, call to mind the sharp distinction between the trend of this development as applied to buildings on the one hand and to bridges on the other. While welding has been applied rather extensively in the construction of new buildings, its use in bridge work, barring a few exceptions, has been confined to the application of additional metal to old structures. It is not necessary at this time to dwell on the reasons for this other than to suggest that it arises from a conservatism on the part of the bridge engineer born of a keen appreciation of the responsibilities which he must bear, and the realization that the present status of the art in assembling plates and shapes by means of rivets represents the result of slowly accumulated experience which he feels must be reproduced in the welding process before corresponding perfection in details will be realized.

Whether or not these apprehensions are warranted, not a few bridge engineers have been quick to realize the outstanding advantages of welding as it concerns the application of additional metal or the restoration or reinforcing of connections of structures already in use.

A welded connection involves no reduction in net section such as is produced by rivet holes. A welded connection is independent of the means by which the component parts of the base material were assembled and held together. For example, if a third plate is to be rivited to two plates that are already connected by rivets, it is necessary to remove the old rivets and to drive new ones through the old holes. Application by welding is subject only to such complications as may arise from interference with the old rivet heads. Thus, welding is simpler and does not, in such cases, entail a temporary weakening of the existing member.

Again, welded connections are not subject in the same degree to restrictions on increases in the strength of connections as are imposed by minimum spacing of rivets, edge distances, and the required clearances for rivet sets. As a consequence, welding often presents opportunities for increasing the efficiency of connections where the addition of more rivets is virtually prohibitive. Welding also affords a means of repairing cracked members which has no counterpart in riveting practice.

The citing of these advantages for welding does not imply that there are no offsetting advantages for riveting work, such, for example, as the ability to apply stitch rivets over the entire area of wide plates without resort to the slotting that is necessary in simulating this practice in welding. Resort to welding also offers no excuse for a departure from accepted practice in design—there is just as much reason for avoiding eccentricity, for example, in strengthening a chord member by welding as when the added material is applied with rivets. In fact, progress in the art of welding as applied to steel bridges will move faster if the work done now is formulated on conservative practice than if it is employed without a thorough weighing of its probable behavior in each detail to which it is applied. Futhermore, the results obtained through its use in reinforcing and repairing old structures, will exert a pronounced influence on the early progress in its application to new bridges.

SHANTIES

Why Not Get Rid of Those No Longer Used?

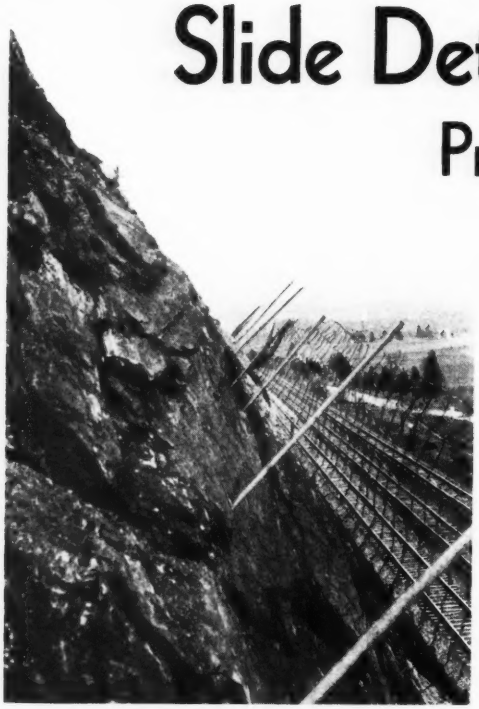
MANY conditions, not all of which are related to the decline in traffic, have brought about a surplus of small railway buldings. More recently this has been caused by the consolidation of divisions, the reduction in the number of supervisory positions and the lengthening of sections, but extending over a longer period changes have taken place that have obviated the need for many pump houses, small passenger stations, repair track and switch shanties, small local store houses, and many odds and ends of buildings that now stand idle.

Some of these structures will be used again when business picks up, but others will not, while still others ought to be retired in any event, because they are ill suited to the purpose intended, involve high maintenance expense, are hard to heat considering their size, and are unsightly. Many of them belong to the groups of "shanty villages" to be found in nearly all of the older terminals, which like Topsy "just growed" as one car body or "shack" was added after another.

What is to be done with these unused buildings? It costs money to keep them from becoming an eyesore along the right-of-way, it will cost something to wreck them, and the objection will always be offered that they "may come in handy some day." But is this argument always a valid one? Take the case of a small house that had been used as the office for a roadmaster or master carpenter or both. If the need for such an office should arise again, the chances are that ample space would be available in some other building. The local passenger station, for example, may have two waiting rooms whereas one may be more than adequate and the other can readily be remodeled to provide better offices and be less expensive to maintain and heat.

Any study of the small utility building is sure to focus attention on the advantages of two alternatives—(1) to consolidate occupancy in a smaller number of substantial structures and (2) to employ unit-constructed houses that may be readily removed and erected elsewhere or increased in size if larger space is needed. Now, when the demand for building space is at a minimum, is a good time to study the small building situation as a whole and develop recommendations for the cure of a condition that has given rise to excessive maintenance expenditures in the past.

Slide Detector Fences
Prove Practical and Effective



One of a Series of Slide-Detector Fences Protecting the Track Alongside a Steep Rock Bluff

Details of construction and operation on the Norfolk & Western where approximately 59,000 lin. ft. are in service

CONFRONTED with many unstable rock and earth cuts in the mountains of Virginia and West Virginia, the Norfolk & Western has become an extensive user of slide-detector fences, having about 59,000 lineal feet in service, with increased safety to train operation and a large saving over manual protection. Of much the same appearance as standard right-of-way fence, but with the wire fastened loosely to non-rigid intermediate posts and connected with the circuits of the automatic block signals through circuit controllers, these fences warn enginemen of earth or rock movements on bluffs or in cuts which might be hazardous to train operation.

Difficult Problem Solved by Fence

With so many side-hill or through cuts on its lines, many as deep as 100 ft. or more and with steep slopes, the problem of watching for fallen rocks or rock fragments which might become lodged on the track was a serious and expensive one. Some earth cuts also give concern, but the greatest problem is in rock, which throughout this territory is largely a faulted mixture of shale and limestone, which is subject to weathering and readily fractured by uneven expansion and contraction during freezing and thawing weather.

At most points breakage and falls are most frequent during the winter and early spring months, and, therefore, the greatest attention has always been given to the inspection and guarding of the tracks during these seasons. However, to neglect such cuts even during the summer, especially in rainy weather or after storms, is to run a risk, so that all cuts giving trouble were kept under observation by watchmen, who either made periodic inspections daily, or were maintained constantly on the track within specified territories. At many of these points, watchmen were maintained on single eight-hour shifts while at others it was necessary to maintain them on two or three such shifts.

The first detector-fence installation on the Norfolk & Western was made in 1926. This proved so effective as a safeguard and in reducing protection expense that from time to time further installations have been made until at the present time fences afford protection at 51 points, at some of which there are as much as 3,000 to 4,000 ft. of fence. The arrangement of the fencing on the bluffs or in the cuts depends entirely upon the contour of the bluff or cut slopes, the main consideration being to so locate the fencing that rock falls will be intercepted under all conditions, and will not be permitted to gain such momentum that they might bounce over the fencing and on to the track without producing a signal indication. Thus many of the installations have three or four lines of fence, usually one along the foot of the slope at or near the track level, with the others more or less parallel at intervals up the slope. Where conditions warrant, lines of fencing are placed along the edges of projecting ridges of steep slopes close to the tracks to intercept any falling rocks which might jump over lower lines of fencing.

Sizeable Rock Falls Cause Train Stops

Installed in sections of definite length and stapled loosely to all but one end post, any pull on the fence, from whatever cause, sufficient to move its free end longitudinally through a distance of ¾ in., opens a circuit controller in the fence installation, which is cut into the line control circuits of the automatic signal system, and causes appropriate signals to assume stop positions. The relative position of the fence with respect to the roadway signals determines just which signals are made to function with the fence movements and the determination whether a train may proceed under caution after being stopped by one of these signals depends entirely upon the character of the signal. In most cases the signals are of the permissive type, so that trains may proceed prepared to stop clear of an obstruction, after they have come to a full stop at the signals.

The fences intercept all sizeable falling rocks, as intended, many of the rocks being of sufficient size to cause operation of the signals. As a result, signals go to danger and trains are thus warned. This causes some delay to the trains involved, and, frequently, unnecessarily, since many conditions are found not to be hazardous. However, this is deemed justifiable in view of the positive safety afforded to train operation and the large saving effected in the expense for watchmen. Installed in such manner that only falls of a magnitude that might possibly cause unsafe operating conditions are reflected in

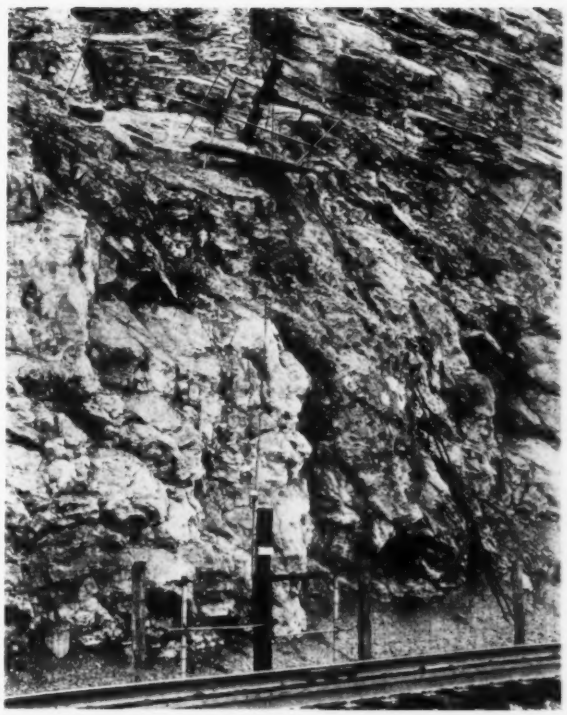
signal indications, the operations of the fence are reduced to a minimum, as are also, therefore, interferences with train movements.

Figures are not available regarding the fence operations and train stops on all of the 51 installations on the road, but figures compiled recently on one division, on which there are 7 fence installations involving 12,000 ft. of fencing, are more or less indicative of conditions in general. On this division, there were a total of 16 signal operations caused by rock falls against the fences between January 1 and April 3 of this year. This record is not considered typical of average conditions since it covers a period in which there was rapid thawing following a severe freeze, during which more than half of the rock falls and signal indications occurred. None of the falls that caused indications presented hazardous conditions, but it is a matter for conjecture as to how many of them might have been dangerous if the fence had not intercepted the rocks. Offsetting the 16 minor delays caused to trains on the division during the first three months of the year, the road secured continuous roadway protection, day and night, without the former monthly expense of $1,150 on this division for the part-time service of watchmen.

Details of Fence Construction

The slide-detector fencing differs from ordinary right-of-way fencing essentially in that it is designed less rigid laterally; has relatively few posts to which the mesh is fixed securely; and has free, movable ends at intervals, connected to signal circuit controllers. One of the essential features of the design is that it is built in operating sections from 200 to 225 ft. in length, even though the fencing may be installed in such manner as to appear to be continuous throughout a length of 1,000 ft. or more. For a short section of fence, up to 225 ft. in length, one end is anchored securely, while the remainder of the fence, to its opposite end, which is connected to a circuit controller, is not of rigid construction. In installations of the fence in lengths greater than 225 ft., up to 450 ft., the outer ends of the fence are fixed while the remainder is of loose construction each way toward a circuit controller station at the center, which is capable of reflecting movements in the fence each side of it. Utilizing these two fundamental arrangements, which may be designated as Nos. 1 and 2 in the order described, any installation, regardless of its total length, can be made up, utilizing a series of arrangement No. 2, with a single unit of arrangement No. 1 at each end. Thus, in long continuous installations, there are circuit controller stations at each end and at intervals of from 400 ft. to 460 ft., allowing for the length of connections to the controller at each controller station. To a large extent, details of the fence construction are shown in the accompanying illustrations.

The anchor posts are 7-in. by 9-in. by 9-ft. treated ties, which are set in concrete and braced securely. At these posts the fence wire, which is of the woven, hog-tight type, 4 ft. high, with smaller openings vertically near the bottom, is attached securely by staples. The intermediate posts, which are usually of the tubular steel type, although timber has been used, are spaced from 10 to 12 ft. apart and are merely set about 18 in. deep in earth. Where these posts must be set on rock, holes at least 24 in. square and 18 in. deep are blasted out and the posts are set and tamped with earth or other light material. At all intermediate posts the fence wire is stapled loosely and, where necessary, the vertical wires of the mesh immediately adjacent to the staples are moved laterally along the horizontal wires, away from the staples, to permit the longitudinal movement of the fencing through the staples of at least six inches in both directions.



Two Circuit Controller Stations, One in a Fence at the Track Level and the Other, Reached by a Steel Ladder, in a Fence About Midway the Height of the Cut Slope

Near the free end of each section there is another rigidly fixed post, set in concrete, usually a treated tie, but this is a line post only, and, as in the case of the intermediate posts, the fence wire is only loosely stapled to it. To permit stretching of the wire uniformly, top and bottom, the wire at the free end of each fence section is attached to a piece of 2-in. galvanized pipe, slightly longer than the height of the mesh. This piece, which thus moves backward or forward in line with the wire as the wire is bellied out or pulled taut, is joined to a similar piece attached to the wire at the movable end of the adjacent section of fence, by means of two ties, one at the top and the other at the bottom, these ties including a section of steel messenger wire, a long, stout coil spring, and a turnbuckle. Through this arrangement the adjacent sections of fence are kept taut under normal conditions, are adjustable, and, at the same time, have ample give to permit separation of the fence section ends in the event that any lateral load or pressure is put on the fencing.

Details of Circuit Controller Stations

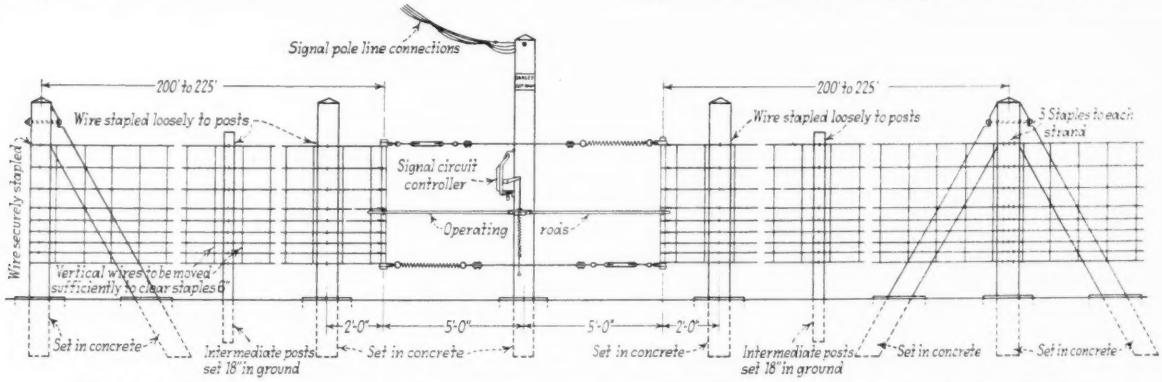
The circuit controller stations are located midway between the movable ends of the fence sections, within the limits of the ties just mentioned, and consist essentially of a two-position, four-contact signal circuit controller mounted on a post in line with the fence, with mechanical connections to both fence sections and electrical connection with the signal circuit. The post carrying the controller is a 7-in. by 9-in. by 11-ft. treated timber, set in concrete, with the controller mounted on one side just above mid-height of the fence.

The mechanical connection of the fence sections to

the controller is through two sections of ¾-in. galvanized pipe bars, securely clamped at one end to the midpoint of the header pieces of each fence section by means of U-bolts, and with their opposite ends engaging a small equalizing bar within a metal guide attached to the controller supporting post. The equalizing bar, which is a short metal piece with tongues on each end to fit into grooves or jaws in the ends of the two operating bars, is connected through a rod on top to the operating lever of the controller, and is put under tension downward by means of a long coil spring.

Operating Position

Under normal conditions, with the adjacent sections of fence in normal alinement, the jawed ends of the operating rods of the fence sections are slipped over the tongues of the equalizing bar within the limits of the guide, the equalizing bar having been forced upward into the guide against the tension of the spring below which tends to pull it and its circuit controller connection downward. In this position, the fence is set for operation. Any pull on the fence sufficient to draw either one or both of the operating rod jaws free of the equalizing bar, frees the equalizing bar, which is pulled downward with its controller connection, opening the contacts of the controller and thereby causing the signals controlled to assume stop indications. Held down by the spring, the controller contacts remain open until the cause for their operation has been removed and the equalizing bar has been returned to its normal position manually.



Details of Detector Fence Construction and of an Intermediate Circuit Controller Station in a Long Fence Installation

The arrangement of the single end sections of a long detector fence installation and the circuit controller mechanism involved are essentially the same as in the double sections described, except, of course, that there is only one operating rod connection to the equalizing bar and circuit controller.

Connection to Signal Pole Line

Where the detector fence sections, in one or more lines, are located on the same side of the right-of-way as the signal circuit pole line, the individual wires of the signal circuit are carried down to the tops of the circuit controller posts of the fence units on messenger wires, and thence pass into the circuit controllers. Where the fence is on the opposite side of the right-of-way, connection to the individual circuit controllers is made through parkway cable carried down the slope and under the tracks.

All circuit controller stations above the track level are reached, where necessary, by either wooden stairs or steel ladders, anchored to the face of the cut or bluff, and each station is provided with a working platform, suitably guarded by pipe railing, to insure the safety of the men charged with the examination and resetting of the controller.

In view of the necessity for installing the detector fences on the highest and frequently the steepest rock bluffs or sides of rock cuts, considerable difficulty was presented in erecting them. At many points entirely inaccessible to men unsupported, it was necessary to build staging up from the track level, and at many other points, particularly in the case of the higher lines of fencing, accessibility was gained only by lowering and sustaining the workmen by ropes.

Supported or suspended by the methods mentioned, air drills, supplied with air from portable compressors at the track level, were used to drill for the shooting necessary in preparing the post holes and the holes for anchoring the platforms at the controller stations. The use of scaffolding or life lines was also necessary at many points in actually setting up the fences. This work was done largely by the bridge maintenance forces of the road because of their familiarity with rock excavation and the methods which had to be employed at many points. All electrical wiring and signal work, on the other hand, was done by the signal department forces. In spite of the difficulties encountered in the fence construction, the average cost of the fences, including all wiring and signal connections, has been only about $1 a lineal foot.

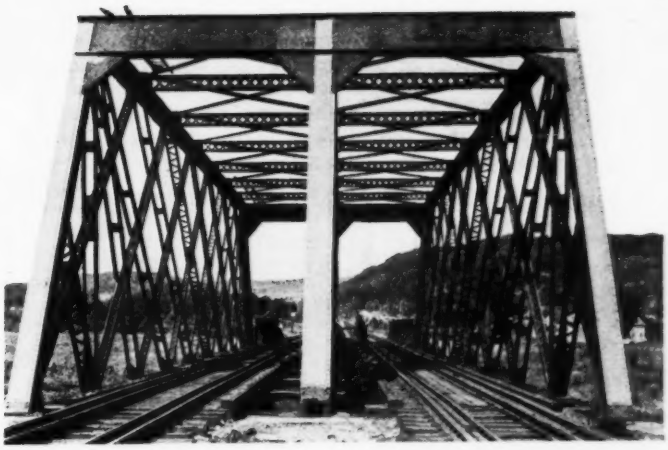
Inspection of Fences

Inspection of the fences and their operating mechanisms is largely in the hands of the signal department, while any sizable repairs to the fences themselves are made by the forces which constructed them. Signal maintainers, passing over their territories on motor cars, can observe the condition of the fences without difficulty. If any of the control mechanisms have been operated, the cause of the operation is removed, if possible, and the circuit controller contacts are restored to their normal positions. If the aid of the section forces is required in any of this work, these forces are called upon.

If a train is stopped through the operation of any of the fence installations, it proceeds under caution until it is beyond the restrictive territory of the signal. The engineman reports the stop indication to the nearest towerman or despatcher, who immediately notifies the signal maintainer.

All of the fence installations on the Norfolk & Western were designed and installed under the general direction of W. P. Wiltsee, chief engineer, with all signal matters in direct charge of D. W. Richards, signal engineer.

Truss Spans Strengthened by Electric Welding*



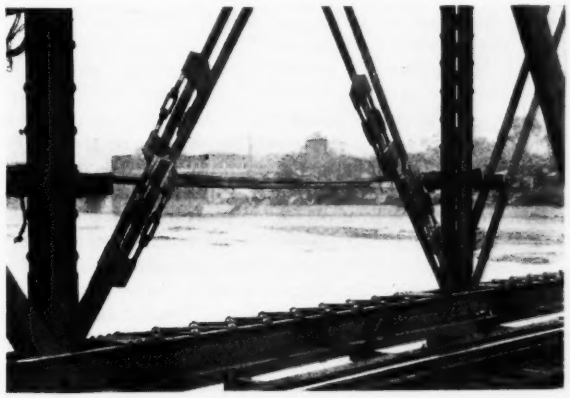
A Through Lattice Truss Bridge on the Erie Strengthened by Welding—Note Added End-Post Cover Plates Between Lines of Rivets

Cross-sectional areas of tension and compression members alike are increased without resort to riveting—Loose diagonals are also tightened

A NUMBER of roads have employed the welding method for strengthening truss bridges, but the road which has done more of this class of work, possibly, than any other is the Erie, which, to the present time, has strengthened 10 through riveted, multiple-system lattice-truss bridges. In all of these structures, which were designed originally to carry maximum axle loads of 35,000 lb., with a total weight on drivers of 140,000 lb., the strengthening was done to permit the operation of four and five-driver locomotives with maximum axle loads of 75,840 lb., and a total weight on drivers of as much as 373,000 lb.

The strengthening of these bridges, which ranged from 130 ft. to 140 ft. in span lengths, varied somewhat with the conditions found, but generally included work on the top and bottom chords, the end posts, and certain of the web members. In the upper chords, which consisted generally of two web plates, four angles and a cover plate, the strengthening was effected by adding a new plate over the existing cover plate, and an additional side plate to each of the web plates. The new cover reinforcing plate was made of such width as to clear lines of rivet heads and to provide for a ⅜-in. fillet weld along each side, and the new side reinforcing plates were made to fit between the chord angles, allowing as much space as possible between the edges of the reinforcing plates and the legs of the angles to facilitate the fillet-welding of the reinforcing plates to the web plates. Two-inch holes were provided in the side reinforcing plates where necessary to clear rivet heads, and these holes were sealed by continuous bead welds around the rivet heads after the plates were put in place. (See Fig. 1.)

*An article on the practices of the Erie and two other railways in the application of the welding process to the strengthening of plate girder spans and viaduct towers, was published in the July issue, page 444.



Tightened Loose Diagonals in a Pin-Connected Truss Where the Pitt-Weld Method, Employing Welded Turn Buckle Assemblies, Was Used

Wide Plates Were Slotted

The reinforcing plates used on the top chords, as well as on the end posts where the reinforcing was of a similar nature, ranged from ½ in. to 1 in. in thickness, and, when over 12 in. in width, were provided with 3-in. by 1-in. slots through the center line, usually on about 3-ft. centers, to afford additional points for welding the new plates to the original plates. All such slots were completely sealed with weld metal to prevent their holding water.

The lower chords, which generally consisted of two web plates and four angles, were reinforced generally by the addition of two side plates, although in some cases a top cover plate was added. In general, details of the side reinforcing plates applied to these members were similar to those in connection with the side plates of upper chords, with the single exception that the center slot welding was not used.

In many cases it was found that the original lower chord section already included side plates between chord angles, riveted to the web plates. Where such plates existed and were of the same thickness as the legs of the chord angles, the new reinforcing plates were made of sufficient width to lap over the edges of the chord angles slightly, and were fillet welded directly to the angles. The thickness of plates added on the bottom chords ranged from ⅜ in. to ⅝ in.

The tension diagonals and verticals repaired in these bridges consisted generally of four angles riveted to-

gether in pairs, with the pairs of angles tied together at intervals by batten plates or diaphragms. The reinforcement of these members consisted generally of two side plates, from ⅜ in. to ½ in. in thickness, and usually about 1½ in. wider than the width of the original section. To apply these plates, it was necessary in some

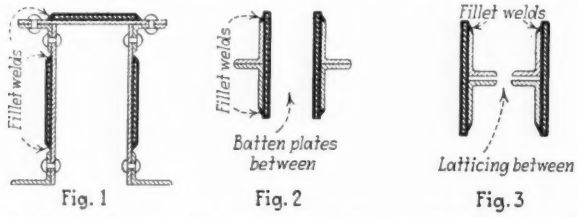
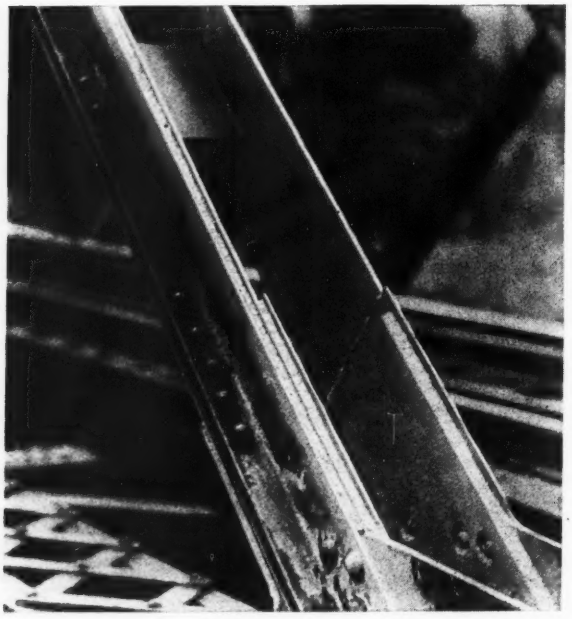


Fig. 1 Fig. 2 Fig. 3

Methods of Strengthening the Top Chords, Tension Web Members and Compression Diagonals, Respectively, of Truss Bridges on the Erie

cases to cut out the batten or diaphragm plates from the old members, and then to weld new plates in position between the reinforcing plates. (See Fig. 2.)

The compression diagonals strengthened were generally four-angle members like the tension web members, except that their shorter legs turned inward through the center of the section and were tied together by latticing. In these members, the reinforcing was also in the form of two side plates, from ⅜ in. to ½ in. thick. In the first work done on compression diagonals, the side plates were made narrower than the width of the original section. With these narrower plates, however, welding details at the intersections of members were not satisfactory,



Close-Up View of a Tension Web Member of a Bridge on the Erie Showing Plates Welded to the Angles and Indicated in Fig. 2

so in all later work, the new side plates were made from 1½ in. to 2 in. wider than the original section. (See Fig. 3.)

While not the longest truss span repaired on the Erie, the one which involved possibly the widest application of the welding method in strengthening work, is a two-track span at Olean, N. Y., which has three trusses and a span length of 130 ft. 3¾ in. center to center of end bearings. In this bridge, 14 members were reinforced in each of the outside trusses and 24 members were reinforced in the center truss. (See Fig. 4.) Altogether, approximately 43,400 lb. of structural steel were added in the strengthening work and approximately 5,500 lin. ft. of welds were made. The approximate cost of the strengthening work amounted to about $10,500, whereas it was estimated that a new bridge to carry the desired loading would have cost in the neighborhood of $63,000.

Tighten Loose Diagonals of Pin Trusses

No pin-connected trusses have been strengthened generally on the Erie by welding, but this road tightened 48 loose main diagonal members in the center panels of four truss spans of a bridge at Elmira, N. Y., using a method which has proved particularly effective. This

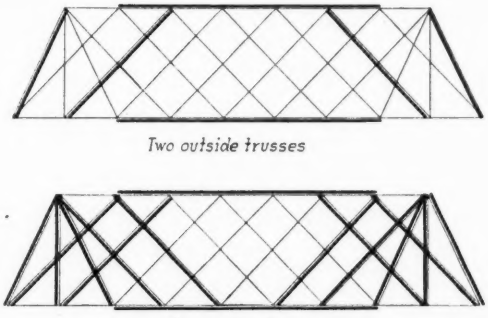


Fig. 4—Sketch Showing Members Strengthened in a Two-Track Truss Bridge on the Erie at Olean, N. Y.

method, which is patented and called the Pittweld method, welds on the two eye-bars of the members two turnbuckle assemblies, whereby the eye-bars can be drawn up to the desired tension.

In general, each turnbuckle assembly includes two heavy turnbuckles with flat extended stubs, four small wing plates and two large wing plates. One of these turnbuckle assemblies is welded to each eye-bar, as shown in one of the accompanying illustration, so that the eye-bars can be cut, transferring the stress to the turnbuckle assemblies, and shortened as desired by cutting out a section of each original bar and taking up on the turnbuckles.

In the Erie work, only a sufficient length of each bar was removed to permit the proper shortening of the members, and all of the shortened diagonals were spliced at the cuts to insure their strength. However, where this same method of repair was employed on a bridge on the Reading, at Ruppert, Pa., the old diagonals were cut out entirely within the range of the turnbuckles, leaving the eye-bar members adjustable at will in the future.

STATEMENT OF POLICY—In a statement of policy issued on July 20 through the Association of Railway Executives, the railroads of the United States pledged themselves to avoid all preventable wastes in the competitive relationship between themselves, to devise and apply the most feasible methods for meeting new competitive conditions, to utilize even more extensively their organizations in the fields of research and experimentation and to take all other available measures to secure the utmost in operating efficiency. The statement which was issued declared that "there is no doubt that the railroads if given equality of opportunity will surmount their present difficulties. To accomplish this we believe that it is essential, in addition to all that the railroads can do for themselves, that the existing regulations of the roads should be relaxed so as to restore freedom of managerial control."

Blasting Effective In Pier Demolition

AN interesting example of the use of explosives in railroad work was afforded recently in the demolition of three reinforced concrete bridge piers of the Pennsylvania, located midstream of the Delaware river about two miles below Trenton, N. J. Those portions of these piers below the water line were each completely demolished with a single shot, without damage to other existing structures, and much more economically than could have been done by other methods.

The Pivot Pier Below the Water Line Was Demolished by One Blast

The piers, which included a pivot pier and two fender piers for a double-track swing bridge, were constructed in 1915 to carry over the Delaware river the projected Pennsylvania and Newark line of the Pennsylvania, a 40-mile low-grade freight line around Trenton, N. J. Neither the bridge nor the line was built, although the project has not been abandoned. Since the authorization of the relatively low-level swing bridge, the War department decided to deepen the upper river to a depth of 20 ft. below mean low water, and, accordingly, ordered the removal of the piers. The order did not affect the approach piers constructed on each side of the channel.

The pivot pier, which was the largest of those demolished, was hexagonal in section above the water, with sides, at the top, 30 ft. 2 in. long, and with faces battered ½ in. in 1 ft., to a wider base 38 ft. 5½ in. from the top, or about 2 ft. below mean low water. The over-all depth of the pier was about 80 ft.

Explosive Loading Planned Carefully

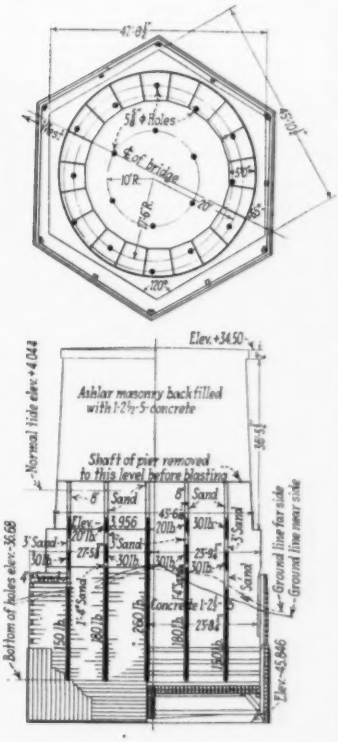
In demolishing this pier, the above-water section, to a depth of about 30 ft., was removed through the use of jack hammers and bench quarrying with relative small charges of explosives. The entire under-water section of the pier, however, to a depth of approximately 36 ft. below mean low water, was removed by a single blast, the charge having been carefully loaded to insure complete demolition.

The loading system for the main blast consisted of 19 holes, 5⅝ in. in diameter and 42.9 ft. deep. These included a center hole, six holes on a radius of 20 ft. near the corners of the hexagonal pier section, six other holes on a radius of 17 ft. 6 in., midway between the outer holes, and six more holes radially in line with the outer holes but only 10 ft. from the center of the pier. All of these holes were put down with a well drill.

A total of 4,160 lb. of dynamite was used in demolishing the pier. A charge of 230 lb. was loaded in each of the six holes of the inner circle, while charges of 210 lb. were used in the holes of the two larger radius circles. The center hole was loaded with 260 lb. of explosive and tamped with eight feet of sand. In all cases, the charges were made up of cartridges 4½ in. by 16 in.

Charges Divided with Sand

With the exception of that for the center hole, the charges were divided by means of tamped sand. In loading the holes on the 10-ft. radius, 180 lb. of gelatin were tamped with 16 in. of sand, 30 lb. with three feet of sand, and 20 lb. with eight feet of sand. All the holes in the two larger circles contained 150 lb. of gelatin with four feet of sand, 30 lb. with three feet of sand, and 30 lb. with eight feet of sand. The heaviest loadings were in the bottoms of the holes and, furthermore, the lowest charges in each hole were of special gelatin dynamite of 75 per cent strength, while those in the upper levels were of 60 per cent strength. This heavy charge, and particularly that in the lower level, was so placed because the pier was heavily reinforced with steel.



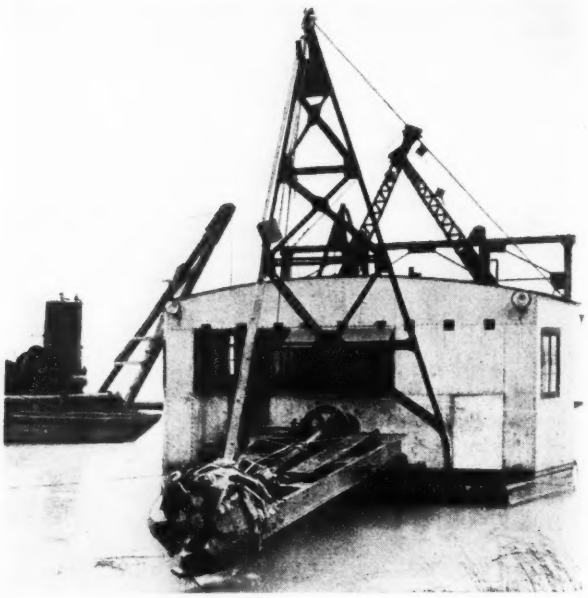
Plan and Elevation of Pivot Pier, Showing Method of Loading for Blast

The method of firing was a single series connection of all the holes with cordeau, which consists of a lead tube of small diameter filled with an explosive compound having a velocity of detonation of about 17,000 ft. per sec. This was detonated with blasting caps.

The demolition of the fender piers, which were somewhat smaller in section than the pivot pier, was accomplished in much the same manner as the larger pier, the explosive loading varying somewhat to conform with the shape and mass of these piers.

Following the demolition of the piers, dredges were employed to remove the debris from the river.

The work was planned under the direction of A. C. Watson, chief engineer, New York zone, Pennsylvania, and T. W. Pinard, engineer bridges and buildings, and was carried out by the Dravo Contracting Company, Pittsburgh, assisted in the blasting details by S. R. Russell of the Explosives department of E. I. du Pont de Nemours & Company.



A 10-in. Dredge With a Revolving Type Agitator

Embankments by Hydraulic

Dredging and pumping systems, embodying equipment carefully designed and selected and properly used, will show sizable savings on many projects

By PERRY NAGLE
Engineer, Pump Division,
American Manganese Steel Company,
Chicago Heights, Ill.

ALTHOUGH the application of the dredging method to excavating and filling work is not new, having been long employed in levee work, it is only in recent years that it has been extended into the field of railway construction. This method finds its widest application in railway work where considerable yardages are involved in the placing of embankments that form the approaches to river crossings as well as in other locations where embankments are adjacent to streams or bodies of water. Increased interest in this method of grading has lately become evident, and the American Railway Engineering Association recently drew attention to the economy of its use where the quantities of material to be moved warrant the installation of the plant and pipe lines.

The hydraulic method has also been applied in several instances to the construction of embankments where the borrow pits are found to be practically inaccessible by reason of the ground being too soft for the employment of the usual means of transportation. In such cases the material is washed down to the intake of a pump, whence it is conveyed by a pipe line to the site of the fill. This method obviates the need for constructing corduroy roads over swampy ground or the building of trestles for dump-car operation.

On the Indianapolis Union

A new fill on the Indianapolis Union Railroad, which was constructed by the C. E. Jefferson Construction Company, Indianapolis, presents a splendid example of the application of the dredging method. In this work, a dredge boat carrying a 16-in. Amsco dredging pump was employed to excavate sand and gravel from an adjacent stream bed and to pump them to the site of the fill. Side levees enclosing the area of the fill were maintained, and a sump constituting an adjustable overflow was built at the lower end of the fill. The retaining levees were carried higher with clamshell buckets as the work progressed and the waste water overflow was raised as the material filled in around it. Heavy planks were applied at an angle against the side levees to serve as baffles to prevent the waste water from washing the fill away in its course to the overflow. The top of the fill was about 52 ft. above the elevation of the water in which the dredge was stationed and at times the 16-in. pipe which conveyed the material was more than 1,200 ft. long.

The dredging equipment in use on this fill, as in practically all other cases, consisted of a specially-designed pump, a power plant, a pipe line through which the dredged material was conveyed, and the boat or dredge on which the equipment was stationed. Auxiliary equipment consisted of a priming device, a hoist for handling the suction line and maneuvering the boat, and an agitating or digging device for loosening tight materials. In some deposits a screen is used to prevent the entrance of material that would clog the restricted passageways that are found in the pump and in the elbows of the pipe line.

Limits of Use

The use of pumping dredges is limited, of course, to operations where (1) an abundance of water is available, (2) where the material is not so tightly compacted that it will not yield freely to some sort of agitation, and (3) where the distance that the material must be moved is not excessive. Ordinarily 3,000 to 5,000 ft. is considered the maximum practical distance, depending on the size of the system, although it is entirely feasible to convey the material through unlimited lengths of pipe line. Naturally, however, this requires additional equipment and attention. The greater advantage offered by the pumping method is that, with the attendance of only a few men, material can be excavated, conveyed, elevated and deposited in an embankment at a comparatively low cost. Moreover, by reason of the action of the water in packing the material solidly in the fill the shrinkage allowance is reduced to a minimum.

The centrifugal type pump is employed exclusively in hydraulic grading. Its size is determined by the diameter of the pipe line with which it is intended to be used. The pumps range from 6 in. to 30 in. or more in size, although the more popular ones are the 8, 10, 12 and 16-in. sizes. The smaller units do not ordinarily convey

Constructed Methods

sufficient material while the larger sizes involve problems in handling the pipe and other equipment, which ordinarily must be done with limited mechanical means.

The amount of solids which a pump will handle represents from 10 to 20 per cent by volume of the amount of water handled by the pump. The capacities, of course, are limited by the pipe line velocity which has been found from practical experience to range from 10 to 15 ft. per sec., depending on the size of the solids carried. At lower velocities heavy solids are not excavated and elevated successfully, while at higher velocities there is a needless waste of energy and the system is subjected to unnecessary shock and abrasive abuses. Ordinarily, the minimum amount of material in cubic yards per hour that a pump of a given size will handle can be determined by multiplying the square of the diameter of the pipe in inches by 0.9. From this it will be observed that an 8-in. pump will handle approximately 58 cu. yd. of material per hour, and a 12-in. pump approximately 130 cu. yd. per hour; these capacities being influenced by the nature of the deposit, by the type of equipment necessary for loosening the material or for screening out oversize material, and to a large degree by the skill of the operators. Generally, the gallons per minute of water necessary to handle the solids can be determined by multiplying the square of the pipe diameter in inches by 26. Both formulas quoted are of an empirical nature.

Design of Pump

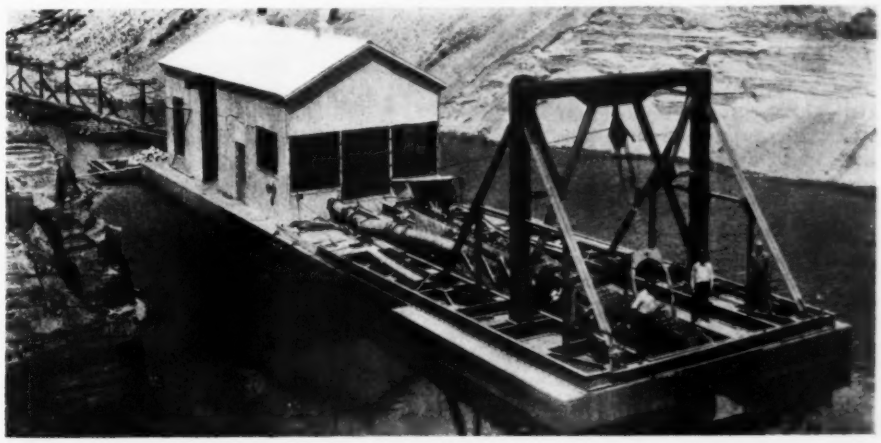
The type of pump used for dredging purposes must be designed (1) with passageways sufficiently large to permit the free movement of large stones and debris, (2) with contours such that the movement of solids is distributed so as to minimize localized abrasion, and (3) it must be constructed to withstand not only the abrasive action of material passing through with the water at substantial rates, but also the shocks set up by the passage of boulders and other weighty pieces, and the strains imposed by water hammer and presence of voids or cavities in the water which occur when a liquid is severely agitated producing the condition known as cavitation. Rigidity and strength in the mechanical construction also are necessary because a substantial power load is called upon to handle the most simple sort of operating requirements. Hydraulic efficiency gives way to practicability and these factors naturally anticipate a rugged, simple piece of machinery with heavy shafting, long and well-lubricated journals, and radial bearings, and adequate provision for taking care of the tremendous thrust loads developed in the pump.

The material of which the parts of the pumping or water end of a pump of this sort are constructed is of particular importance to the operator since it must be capable of withstanding the abrasive abuse of all sorts of different materials, as well as the impact and the severe strains set up by cavitation. The special advantages which the nature of the work demands are offered by manganese steel which is practically always employed. The high strength and toughness of this metal provide high resistance to shock loads of any sort. Endless trouble may be caused by the failure of the impeller or shell of a pump during a busy pumping season as the result of the passage of a large boulder, while dredges have been known to sink as the result of one of the heads or side plates collapsing under water hammer or cavitation and allowing water to rush back into the boat from the discharge line. It is for such reasons that manganese steel has practically replaced the more brittle materials, which, in some cases, show relatively high abrasive resistance.

Operation of Intake Pipe

The most important consideration in the operation of a pumping dredge is involved in the manipulation of the suction or entrance pipe. This member is usually provided with a piece of suction hose or other flexible member that enables it to be lifted and lowered and, in some instances, to be moved from side to side. The length of the entrance pipe is influenced in most instances entirely by the provision made for handling it, although, if the pump is stationed too high above water level, its length may be influenced by the loss of vacuum-creating effort. In general, however, entrance pipes are never longer than 60 or 100 ft., and may be as short as desired.

It is advisable to maintain as high a concentration of solids as possible without risking the serious difficulty of line clogging in order to increase the pay load, and to minimize high line velocities and the attendant high abrasion. This can be accomplished only by the close attention of the operator in keeping the entrance end of the suction pipe in close proximity to the deposit



A Suction Dredge With a Swintek Traveling Screen Ladder

and by his skill in adjusting its position for the proper proportioning of the water and fill material.

Where the material is packed loosely, dredging becomes a relatively simple matter, but in other deposits, such as those that are cemented together with loam or clay, agitation of some sort is necessary to loosen the

The Fill Behind an Abutment After One Week of Pumping With the Side Levees Being Thrown Up With a Grab Bucket

material preparatory to taking it into the system. Sometimes this agitation can be effected with nothing more complicated than jets of water directed into the material in the region around the suction nozzle. This is effective, however, only under special conditions. The agitator in most general use is of the revolving cutter type, which consists of a heavy structural-steel ladder supported in trunnions at the bow of the boat and provided with a cutter resembling an auger at the lower end and the necessary driving mechanism at the deck end. The intake opening of the suction pipe is located within the revolving cutter and as the cutter traverses the deposit the revolving blades loosen the material so that it may be drawn into the pumping system.

These cutters are of various designs, depending on the type of material which they are designed to loosen. Some, which are designed for loosening sand or cutting clay, consist of relatively sharp demountable manganese

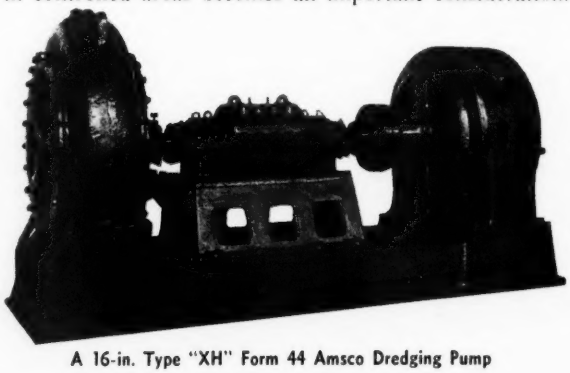
Discharge From 16-in. Dredge Beginning the Fill Next to an Abutment. The Pipe Line at This Point Was 1,100 Ft. Long

steel blades assembled on a spider, while others, designed particularly for loosening tightly-cemented gravel or for cutting into shale rock and matrix formations, are much more heavily constructed and are generally in one piece with the blades and spider cast integral. The latter are sometimes fitted with heavy demountable teeth. Because of the severe punishment to which they are subjected, manganese steel is especially desirable in these cutters.

In deposits containing large boulders a traveling screen, known as the Swintek machine, is effective. This device consists of a heavy ladder built around the suction pipe and about which a heavy endless chain is made to travel in such a manner that all material taken into the system must pass through this chain, which acts as a screen. The chain is provided with heavy hook links which serve to agitate the material to a limited degree but whose more important purpose is to remove oversize material from the intake region and convey it up the ladder, depositing it either into scows or back into the water away from the operating area. The agitating effect of the Swintek machine is not as great as that of the revolving cutter; nevertheless, it has been used to good advantage in deposits which are packed fairly tightly.

In borrow-pit operation the material is loosened under the action of a powerful stream of water directed at the bank from nozzles or monitors and is washed into a hopper-shaped sump from which the pump takes its suction. Where oversize material is encountered, the sluiced material passes over a grizzly before entering the sump to remove all boulders and debris. In this type of operation, the pump and driving units are mounted on dry ground and do nothing more than lift and convey the material.

After the material has been introduced into the system no close attention is necessary until it is deposited at the end of the pipe line. Because of the amount of water involved in the practice, the retention of solids in controlled areas becomes an important consideration.



A 16-in. Type "XH" Form 44 Amsco Dredging Pump

In general, "bleeders" are used, which are nothing more than valves spaced at intervals along the bottom side of the discharge pipe in the region where the deposit is to be made. The smaller solids, being conveyed along the bottom of the pipe, are discharged through the "bleeders" and all the oversize material is discharged at the open end, where the principal amount of water is also ejected. Sometimes this superfluous water can be conveyed away from the fill, either by additional pipes or flumes without the risk of having the fill washed away.

Even with the use of "bleeders" the material has a tendency to spread out considerably and, in general, unless dams or baffles are employed, the use of tractors or horse-drawn scrapers is necessary to build up the slopes. In many instances the material is deposited behind earth dykes which form a reservoir or a series of them on the top of the fill, thus permitting the water to seep away. An added advantage of this system is that the seepage has a tendency to fill the voids with fine sediment, thereby tending to minimize the shrinkage. The dykes are heightened as the fill progresses.

In some fill work, the material, after being dredged by the pump, is delivered to some sort of a dewatering device where it is subsequently loaded into trucks or cars and conveyed to the fill. In still other work, the material, after being excavated by means of power shovels, is conveyed to a hopper, from which a dredging pump is used to deliver the material to the fill.

Shutting Off Bad Water in a Deep Well

THE seepage of unsuitable waters through the casing of a 556-ft. well on the Texas & Pacific at El Paso, Tex., imposed a perplexing problem that gave rise to ingenious methods of ascertaining the exact cause of the trouble and equally interesting methods of sealing off all strata except the one supplying a good quality of water.

Prior to 1924, the locomotive water supply at El Paso was obtained from relatively shallow wells ranging from dug wells 15 ft. deep to drilled wells having depths up to 250 ft. The water was very bad, carrying approximately 24 grains per gallon of sulphate hardness, 20 grains of sodium chloride and 12 grains of calcium and magnesium carbonates. A successful effort was made in the latter part of 1924 to develop a supply from a lower stratum which was found between depths of 432 and 556 ft., the water rising to within 18 ft. of the surface. A single casing of 41.25 ft. of 12-in. pipe, one 18-in. swedged nipple, and 513.75 ft. of 8-in. pipe was used with outside lead packers set in clay at depths of 410 and 427 ft. respectively. The bottom 83 ft. of 8-in. casing is perforated with 3/16-in. slots. The pumping equipment installed consists of a vertical-type motor direct-connected to a deep-well turbine which was set with its bowls 121 ft. below the ground surface. The water produced from this stratum analyzed as follows:

Calcium carbonate	5.04	grains	per	U. S.	gal.
Magnesium	2.44	"	"	"	"
Iron and aluminum oxide	0.19	"	"	"	"
Silica	1.24	"	"	"	"
Sodium sulphate	5.29	"	"	"	"
Sodium chloride	5.50	"	"	"	"

Trouble was experienced in using this water in power plant boilers and switch engines, flue and flue-sheet renewals being required in from 12 to 14 months. Various kinds of boiler compounds were used until 1928 with but little improvement, after which a green-sand zeolite plant was installed which gave good results.

Casing Develops Leak

Late in December, 1930, after the attendant reported that the plant was not functioning as it should, the pumping and treating of the well water was discontinued and city water was used instead. A check of the well water showed a hardness of about 40 grains instead of 9, which indicated that hard water from strata at higher levels was leaking through the casing. The pumping unit was removed and a close inspection was made of the column pipe. This disclosed a bright spot about 1½ in. in diameter at a point 41 ft. below the ground surface and no explanation for this could be offered other than that it was due to the action of sand and water coming through a hole corroded in the casing. Means had to be devised to stop this leak.

To do this the well was blocked with a plug of burlap bags extending from Elevation -46 ft. to Elevation -36 ft. A two-inch pipe was then jetted down outside the casing to about Elevation -46 ft. and a pressure pump, connected to the two-inch pipe was employed to deliver cement grout around the outside of the casing to encase it and shut off contaminating waters.

After a period of five days, the top of the plug was lowered to Elevation -46 and weighted, the well was bailed out to that elevation and no leaks through the casing could be found. The plug was then removed and the pump was reinstalled and operated at the normal rate of discharge for a period of 24 hours. An analysis of a sample of the water taken at the end of this time disclosed a hardness of 27 grains per gallon, or 13 grains less than that of the water taken before the grouting was done, but still 18 grains in excess of the hardness of the water originally developed from the stratum below Elevation -432. This indicated that the leakage near the top of the well had been effectively stopped and led to the conclusion that hard water from strata at an elevation above -432 was finding its way down outside the casing and entering through the 8-in. perforated casing at the bottom of the well. The next step was to devise means of shutting off this flow, which obviously called for the forcing of grout through the perforated pipe and up around the casing above the -432 ft. level, while protecting the major portion of the water-bearing strata below that level against the sealing effect of the grouting operation.

Perforated Pipe Filled With Mud

This last requirement was taken care of first. After removing the pump and measuring the well in order to be assured of its depth, enough stiff mud made of a good clay was put in the well to fill the perforated pipe to within five feet of its top, two sacks of hydrated lime mixed with water being poured in the well to precipitate the suspended mud (the water standing at Elevation-18). After 48 hours, 3 sacks of cement were mixed into a thin grout and poured into the well, the static head remaining the same.

After a period of five days the remaining depth was carefully measured and the top of the filling was found to be approximately three feet below the top of the perforated pipe. A force pump of 100 g.p.m. capacity was then connected to the top of the casing and through it 29 sacks of cement were introduced, in the form of thin grout. The pump labored heavily after the 25th sack and practically stopped on the 29th sack, when working under 130-lb. pressure.

Clear water was then pumped into the well for about one hour, during which time not to exceed 3,000 gal. were used to force the grout through the perforations and shut off the contaminating waters. A valve on the discharge side of the pump was then closed to hold the pressure and the pump was disconnected. The well was not disturbed for one week, after which measurement showed that the perforated pipe was not completely filled. The plug of mud, lime and cement at the bottom of the well was then removed with a bailer.

Reduces Hardness

Following this, the turbine pump was reinstalled and after a pumping period of 48 hours an analysis of the water showed that the hardness was at the original 9 grains per gallon, and it has not since varied from that figure. This shows that all contaminating waters were successfully cut off by this method of correcting defects in the outer casing of the drilled well at a cost of about one-eighth of that of a new well plus the cost of sealing off the contaminating waters from the old well which would have had to be abandoned.

The correction of the conditions in this well were carried out under the direction of R. L. Holmes, engineer of water supply of the Texas & Pacific, and under the general supervision of E. F. Mitchell, chief engineer, to whom we are indebted for the information presented above.

A Platform of Screenings Between Concrete Curbs

What Kind of

Types of construction and passenger stations vary with

THE type and character of platform suitable for a particular location depend on the kind and volume of railroad traffic, whether it is to be exposed to the elements, the probability of a change in the line or grade in the future, and the character of the station. Passenger platforms constitute an important focus of contact between the railways and the traveling public, and attractive appearance has an advertising value that should receive consideration. The better classes of platforms are surfaced with brick, concrete or asphaltic materials, while unpaved filled or wood types are used where conditions warrant. In any case, proper design, finished workmanship and adequate maintenance are essential to secure the maximum service.

Freight platforms at receiving, delivering and transfer stations require surfacing materials capable of resisting the wear imposed by truck traffic. The surfaces of such platforms are subject to more severe service than sidewalks or highways because of metal-tired trucks handling heavy freight. In such locations, where hard-surface platforms are used, rubber-tired truck wheels will reduce maintenance and handling costs.

In selecting platform surfacing material for a certain location, the following factors should be given consideration: (a) Appearance, (b) cost of operating trucks (including tractive resistance) unless for passenger service only, (c) first cost, (d) yearly maintenance, (e) service life, (f) noise, (g) smoothness and regularity of surface, with special reference to loss and damage claims, and (h) safety.

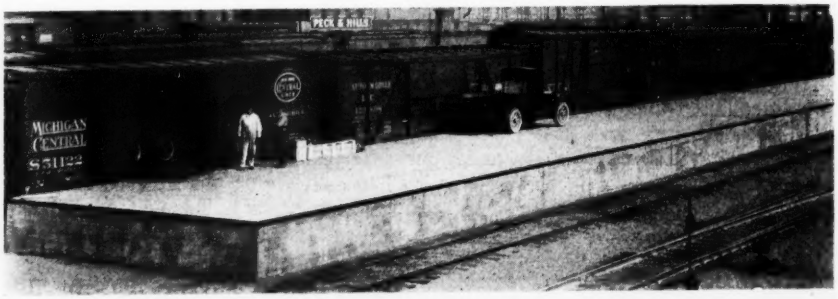
The low first cost of the unpaved filled type of platform makes it suitable for unimportant way stations and temporary construction. Loose types of pavement, however, function unsatisfactorily under heavy traffic and severe expose, becoming dusty in dry weather and muddy in thawing weather. Other disadvantages are their relatively high cost of maintenance and generally poor surface and appearance. The surfaces of unpaved filled platforms are often improved by the application of stone screenings, watered and rolled, or a thin coat of screenings having an asphalt binder.

The use of untreated wood exposed to the weather is appropriate for temporary locations or dry localities, although untreated sleepers resting on or embedded in the ground are short lived. Planks carried on joists or sleepers will last longer due to better ventilation, and joists and/or stringers supported on blocking or posts will last 8 or 10 years before increasing maintenance makes renewal imperative. The average life of untreated, uncovered wood-plank platforms for freight trucking in the Southwest is about six to nine years, depending on the traffic, location and kind of lumber used. Properly treated timber will last longer under all these conditions except where maintenance is due to wear from traffic. Maple or other hardwood boards are generally satisfactory for severe trucking service.

Brick Platforms

An exterior platform surface of hard burned shale brick has a good appearance, wears well, may have salvage value and is easily repaired. Such platform surfaces, however, require a thoroughly compacted foundation and are suitable particularly for low passenger platforms. First-class vitrified shale bricks have a high resistance to abrasion and when properly laid will withstand heavy trucking. On the other hand it is difficult to clean snow thoroughly from brick surfaces and they are noisy under steel-tired trucks.

Preformed asphalt planks or blocks and mastic asphalt platforms have been used to some extent in passenger and freight stations. Steel-tired trucks are less noisy on asphalt surfaces and such surfaces function better under trucking than under piled or standing loads, particularly in hot weather. In addition, they may be



An Automobile Unloading Platform of Concrete

* Abstracted from the report of the Committee on Buildings of the American Railway Engineering Association, which was presented at the convention on March 16. A. C. Irwin, Portland Cement Association, was the chairman of the subcommittee.

a Platform?*

material to be used for and freight houses conditions

This Concrete Passenger Platform Is in Harmony with the Architecture of the Station

repaired without much traffic interference. Cast-in-place asphalt mastic, however, where not subjected to truck traffic, tends to crack and become unsightly. The degree of success that is attained in the use of asphalt mastic surfaces will be determined largely by the selection of the proper proportions and kinds of ingredients and their intelligent application.

Concrete Platforms

Concrete has been used extensively for platforms at both major and minor freight and passenger stations. It has the advantages of cleanliness and good appearance and the ease with which snow and ice can be removed. It is economical as to first cost where a hard surface is required and offers low resistance to trucks as long as the surface remains smooth, and is adapted to high as well as low platforms. If subjected to rubber-tired traffic only, a well-built concrete platform will give long service without much expense for maintenance and meets the requirements of whatever fire hazard there may be present. Precast slab platforms have been used to a limited extent and have some advantages.

Heavy traffic handled with iron or steel-tired trucks will, in time, abrade concrete surfaces, especially at the necessary expansion and construction joints, unless special construction at such places is used, and the noise of steel tires on concrete surfaces may also be objectionable. Moreover, repairs to concrete platforms interfere with their use, and unless done properly will not be permanent. The use of high-early-strength concrete will minimize the time required for curing, but in any case esperienced and intelligent workmanship is necessary for best results.

Standard designs for platforms to cover all localities, station dimensions and other requirements obviously are impracticable, but some general limitations and considerations of design are possible. Island platforms used for passenger traffic only should provide a line of travel from arriving trains and another to departing trains. For such platforms a minimum width of 13 ft. is recommended. Traffic to departing trains (except suburban trains) will be much lighter than from arriving trains, but a width to accommodate passengers from two trains arriving simultaneously is not justified.

Island platforms for both passenger and truck traffic under normal conditions should preferably be 18 ft. wide. This will allow space for one line of truck traffic, one row of columns and one line of passenger traffic to and from trains. Combination platforms in front of stations of medium size preferably should not be less than 20 ft wide. If practicable, platforms used exclusively for trucking should be free from columns, and should provide room for trucks to pass each other. Hand-trucking platforms between tracks should be at least 8 ft. wide if uncovered and 10 ft. wide if covered. Freight-house platforms on the track side should be at least 8 ft. wide for hand trucking and 12 ft. for power trucks. A minimum width of 15 ft. is preferred for platforms at way stations where baggage, mail and some express are handled, while freight transfer platforms with one row of columns carrying butterfly or umbrella canopies preferably should not be less than 12 ft. in width for hand trucking and 13 ft. wide if tractors and trailers are used.

Low passenger platforms should never be lower than the top of the rail, and preferably not less than four inches above it in order to allow for a possible future lift of the track if on ballast. Passenger platforms at the car-floor level in large terminals are safer and much more convenient than low platforms, and save time, particularly in discharging passengers. Trucking platforms in large passenger terminals should be of sufficient height to bring the truck approximately to the car-floor level.

High passenger platforms that are not supported directly on fills should be designed for a uniformly-distributed normal

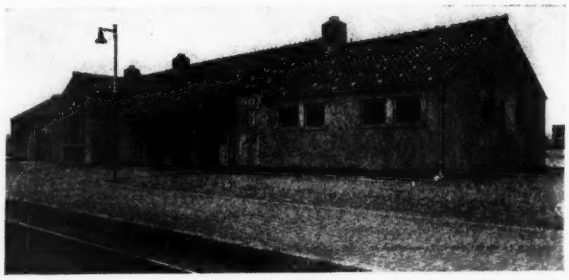
This View Illustrates an Automobile Unloading Platform of Wood

live load of 100 lb. per sq. ft. and freight platforms for 300 lb. per sq. ft. If the platform is to be subjected to abnormal load concentrations it should be designed accordingly. Adequate drainage should be provided for platforms by sloping the surface from the building to the curb, and island platforms should be crowned, while a system of gutters and down spouts should be provided for covered platforms.

The practice of painting a broad line parallel to the tracks to indicate a safe limit of distance from the edge of the platform is recommended. The ends of high platforms should be protected with a substantial railing while the ends of low platforms should be sloped off to the ground if the end height is more than six inches. The use of anti-slip surfaces on passenger platforms should be given consideration as a safety measure, and at the same time a smooth, hard-troweled surface on a concrete platform should be avoided. In order to provide non-slip surfaces, carborundum grains are sometimes applied in finishing concrete platforms.

Curbs should always be provided next to tracks. If not designed as a retaining wall, the curb should be anchored into the filling material. For island platforms, the anchorage may well pass through the fill from curb to curb. More permanent curbs are constructed of stone or concrete, and in cold climates these are sometimes anchored downward into the soil to prevent heaving by frost.

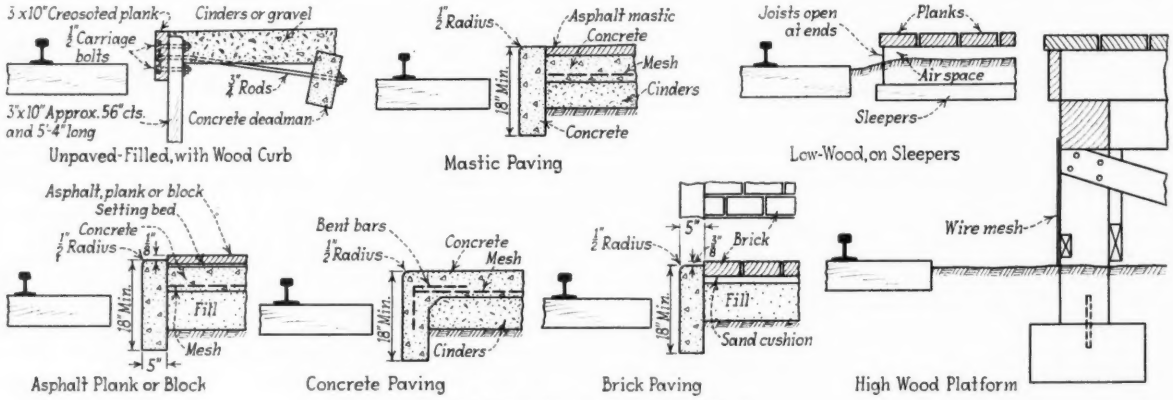
The ground under the fill should be leveled off and soft spots dug out and filled with sand tamped in dry or puddled into place. The top of the compacted base should be parallel with the finished surface and at a distance below it depending on the character of the surface. For a topping of stone screening, this distance



A Typical Brick Platform

In platforms with wood surfaces, the thickness of the planks and the spacing of the sleepers or joints should be such that the deflection between supports is very small even under the heaviest load concentrations. An air space should be provided under the surface and between the individual planks or boards and a wood surface resting directly on the fill with embedded nailing strips is not recommended. Tongued and grooved material is not suitable for an outside platform surface, even if covered by a canopy. Generally, the boards or planks should be laid parallel with the direction of traffic, although in platforms provided exclusively for passenger service, or for very little trucking, the surface may be laid transverse to the line of travel.

If heavy truck traffic is to be carried by the platform, something more stable than a compacted fill must be provided, or the surface itself must have load-distributing power. An economical way to obtain the required strength is to place and finish a concrete slab not less than five inches thick on the compacted base. The use



Sectional Drawings of Typical Platforms

should be not less than 1 in.; for an asphalt surface, not less than 1½ in.; for brick, not less than the thickness of the brick plus a ½-in. sand cushion; and for concrete, not less than 4 in.

Unpaved Surfaces

The surface of unpaved filled platforms should be of a granular material, such as slag, cinders, shells, stone screenings, etc., that will not become muddy when wet. The surface should be compacted by rolling and/or tamping, and crowned or sloped for drainage. The application of a topping of stone screenings and stone dust, watered and rolled, is common practice. Surface coatings of oil assist in laying dust but are objectionable because the oil may be carried into stations and cars. A thin coating of stone screenings with an asphalt binder makes a good and inexpensive surface.

of so-called hardeners or densifiers in a concrete-wearing surface has some merit. In placing the concrete, proper materials, proportions, workmanship and curing are necessary to guarantee success. Excessive troweling is to be avoided. A surface that is sloppy when finished will not withstand the wear expected of it. Neither the base nor the topping of a two-course monolithic job should have any more water in the mix than the minimum necessary to secure proper compaction and finishing.

Only a hard, durable aggregate should be used in the topping; cherty aggregates are hard but not always durable. "Popping" and "pitting" of the surface is due to the use of aggregates that disintegrate when subject to cycles of freezing in a saturated condition. These results are to be avoided especially in platforms subject to heavy trucking.

In brick-surfaced platforms, the base must be firm

and unyielding. The sand cushion should be as thin as practicable and compacted thoroughly before the brick surface is laid. The joints should be sand filled after the bricks are in place. Hard burned shale bricks are suitable for passenger platforms, but vitrified shale bricks should be used for freight-trucking platforms.

The melting point, penetration and other properties of asphalt for platform surfaces should conform with the requirements found best suited to the particular climate in which the asphalt is laid. Asphalt surfaces for freight platforms preferably should be laid on a concrete base, but for passenger and light traffic freight platforms a well-compacted stone ballast base or a penetration asphalt and stone base on a settled and firm subgrade may be used. The thickness of the asphalt wearing surface should not be less than ¾ in.

High platforms, such as those for freight houses and transfer platforms that are not carried on fills, are usually of steel, wood or concrete, or a combination thereof. The all-wood platform is usually most economical as to first cost, and cresoted lumber should be used for the supporting portion except for temporary locations. The wearing surface may properly be of untreated lumber, especially for freight traffic where the influence of wear is most important.

What Engineers Are Paid

OF THE 1,344 railway officers of all classes who received salaries of $10,000 or more a year on December 1, 1929, 82, or 6 per cent, were in the engineering department, according to a compilation made by the Interstate Commerce Commission and printed in Senate Document 129. The compilation lists not only the salaries as of the above date, but also the rates paid as of March 1, 1932, the purpose, presumably, being to disclose the reductions in compensation effected in the intervening period. In the number of instances salaries have been further reduced subsequent to the latter date.

Below is an abstract of this tabulation, limited to officers listed as chief engineers, assistant chief engineers, engineers maintenance of way and other engineering officers:

	December 1, 1929	March 1, 1932
Atchison, Topeka & Santa Fe System		
Chief engineer system	$15,000	$13,500
Assistant chief engineer system	12,000	10,800
Atlantic Coast Line		
Chief engineer	18,000	16,200
Baltimore & Ohio		
Chief engineer	15,200	13,680
Chief engineer maintenance	11,200	10,080
Chief engineer B. & O. Chicago Terminal	12,000	10,800
Assistant to chief engineer—Formerly chief engineer Buffalo, Rochester & Pittsburgh	15,000	9,000
Boston & Maine		
Chief engineer	13,000	11,700
Canadian National (Grand Trunk Western)		
Chief engineer	10,000	10,000
Central of Georgia		
Assistant general manager and chief engineer	8,400	10,800
Central of New Jersey		
Chief engineer	12,000	10,800
Chesapeake & Ohio (Including Hocking Valley)		
Engineering assistant to president	12,000	10,800
Chief engineer	13,000	12,600
Chicago & North Western		
Chief engineer	18,000	14,400
Assistant chief engineer	13,000	10,400
Engineer maintenance	12,000	9,600
Chicago, Burlington & Quincy		
Chief engineer	13,000	11,550
Chicago, Milwaukee, St. Paul & Pacific		
Chief engineer	15,000	13,500
Engineer maintenance of way	10,000	9,900
Chicago, Rock Island & Pacific		
Chief engineer	12,000	10,800
Delaware & Hudson		
Chief engineer and chairman of valuation committee	10,000	9,900
Delaware, Lackawanna & Western		
Chief engineer	15,000	13,500
Erie		
Chief engineer	10,800	9,720
Chief engineer maintenance of way	10,800	9,720
Great Northern		
Chief engineer	15,000	13,250
Assistant chief engineer	10,000	9,000
Assistant chief engineer	10,000	9,000
Illinois Central		
Chief engineer	15,000	13,500
Engineer maintenance of way	11,500	10,350
Chief engineer Chicago Terminal Improvements	12,500	11,250
Lehigh Valley		
Chief engineer	14,000	12,600
Chief engineer maintenance	10,000	9,000
Louisville & Nashville		
Chief engineer	11,000	9,900
Minneapolis, St. Paul & Sault Ste. Marie		
Chief engineer	12,800	10,800
Missouri-Kansas-Texas		
Chief engineer	15,000	12,000
Missouri Pacific		
Chief engineer	16,500	13,750
Engineer maintenance of way	10,000	8,333
Nashville, Chattanooga & St. Louis		
Chief engineer	10,000	8,100
New York Central Lines		
Chief valuation engineer	10,000	9,000
Chief engineer lines East	18,000	16,200
Assistant chief engineer lines East	12,000	10,800
Chief engineer lines West	11,000	9,900
Chief engineer maintenance of way	13,000	11,700
New York, New Haven & Hartford		
Chief engineer	12,000	8,100
Norfolk & Western		
Chief engineer	12,000	10,800
Northern Pacific		
Chief engineer	12,000	10,800
Pennsylvania		
Chief engineer	25,000	22,500
Assistant chief engineer	13,200	11,880
Assistant chief engineer—maintenance	14,000	13,500
Chief engineer Philadelphia Improvements	14,400	12,960
Engineer Baltimore Improvement	13,200	11,880
Chief engineer Eastern region	17,500	15,750
Chief engineer Central region	17,500	15,750
Chief engineer Western region	17,500	15,750
Chief engineer New York Zone	17,500	15,750
Engineer bridges and buildings	10,000	9,000
Engineer bridges and buildings	10,000	9,000
Engineer of standards	12,000	10,800
Engineer Newark Improvements	10,000	9,000
Chief engineer maintenance of way New York Zone	12,000	10,800
Chief engineer maintenance of way Eastern Region	15,000	13,500
Chief engineer maintenance of way Central Region	15,000	13,500
Chief engineer maintenance of way Western Region	15,000	13,500
St. Louis-San Francisco		
Chief engineer	15,000	13,500
Southern		
Chief engineer	12,000	10,800
Southern Pacific		
Chief engineer Pacific Lines	18,000	16,200
Engineer maintenance of way and structures, Pacific Lines	12,000	10,800
Chief engineer, Texas and Louisiana Lines	10,000	9,000
Texas & Pacific		
Chief engineer	12,500	10,625
Union Pacific		
Chief engineer system	12,000	10,800
Virginian		
Chief engineer	12,000	10,800
Western Pacific		
Chief engineer	12,000	11,880

Stressing the Individual in Safety Work*

Comprehensive safety program of the Delaware & Hudson is designed to reach every man in each gang

By J. C. DORSEY
Division Engineer, Delaware & Hudson, Albany, N. Y.

IN 1925 a safety committee consisting of maintenance of way supervising officers was organized on each division of the Delaware & Hudson. This committee was composed of the division engineer, who acted as chairman, the division engineer's chief clerk, acting as secretary, the roadmaster, the bridge and building master and the supervisors of track, bridges, buildings and water service, as well as of other representatives of the engineering and stores departments, there being a total of 17 members. The membership in this committee is permanent, except for changes in department personnel, so that there are no periodical changes. Thus, normally, every member of the committee is fully acquainted with the complete history of the division safety work, and by virtue of this experience is well qualified to assist in the handling of any safety question that may arise suddenly on the road or in a committee meeting.

Meetings Are Basis of Success

The committee meeting, which is held regularly once each month, has a regular order of business which is, as much as anything, an accounting of the safety activities of the previous month. The members of the committee feel that these meetings furnish the basis for any success that we may have experienced in our safety work. For this reason a knowledge of the manner in which they are conducted is necessary to a clear understanding of our safety methods.

The first business after the roll call is the reading of the minutes. In this connection it may be said that a 100 per cent attendance is compulsory so far as this is possible. The subject matter of the minutes is quite different from that of other assemblies. Our safety department devised a card form to be handled as railroad mail and placed a supply of them in convenient holders at all stations so that anyone observing an unsafe practice or condition is at liberty to report the matter to the chairman of the safety committee with suggestions as to the proper remedy. The items from these card reports, together with similar items reported orally during the committee meeting and a record of the corrective action taken in each case, constitute the minutes. Each of the items is referred to the committee member whose duties embrace the particular nature of the work involved. He undertakes to make the correction or reports back to the committee the difficulties encountered and asks for any advice or assistance that may be necessary.

The items are carried on the minutes until disposed of by correction or, as is sometimes the case when an item involves matters outside the jurisdiction of the committee, such as standard practices or authority for expenditure, until it is referred to the superintendent of safety or the management for action. As the minutes are read item by item with the corresponding report on each, opportunity is afforded all members to criticize freely the means taken to make corrections and often, particularly when an item has not been handled to completion, a statement of the difficulties encountered by the committee member to whom the matter has been referred precipitates a lively discussion, which constitutes the real evidence of the interest of the members. This phase of the meetings serves to draw out varying view points in regard to certain hazardous conditions, and has a tendency to suggest to each member that he might be overlooking some phase of the matter on his district.

The minutes give each member an insight into the general safety conditions on the division, since the number of items reported becomes a reliable index of these conditions. The items received have been found to diminish in number as time passes and eventually the minutes become quite brief; in fact very few safety cards are now being received. Of course this does not mean that the division is nearly 100 per cent perfect as regards safety or that hazards have been eliminated, but it does mean that improvement has been made and that items for correction are not readily encountered.

Reports of Members

The second item of business is the reading of the reports of the individual members. These reports consist of statements by dates of what the member has done personally since the last meeting toward correcting unsafe conditions and practices. In addition, each member brings to the meeting similar reports from the foreman of each working gang in his charge. The importance of these reports as a means of reaching every workman on the division should not be under-estimated. The report of each foreman actually is a report of the gang as a whole, that is, it recites the safety activities not only of the foreman but also of each man in the gang.

If it pays to advertise anything, with us it pays to advertise safety. We must make the safety-first idea known to every employee and we must lead every employee to take an active part in the work. As a means to this end as well as to obtain real evidence of the interest of the individual employee in safety work, every working gang has been formed into a local safety committee as an auxiliary to the general committee.

Each Monday morning, before leaving the tool house, the foreman holds a five-minute safety meeting with his men, urging them to exercise care, to observe the safety rules and to watch for unsafe conditions. Each week a

*Abstract of a paper presented before the annual meeting of the Safety Section, American Railway Association, at Chicago.

member of the gang is appointed to act as safety man and, in addition to his regular work, it is his duty to observe himself and his companions with the safety-first thought in mind and to collect items to be included in the report of the foreman. This practice brings to the attention of the individual a sense of his own responsibility in the matter of safety.

That this extension of the activities of the division safety committee to the individual gangs has had a profound influence in obtaining good results, is evidenced by the following figures:

Year	*No. of items reported*	*No. of injuries to trackmen*
1925	1,266	40
1926	10,380	41
1927	24,228	16
1928	30,065	17
1929	39,861	11
1930	48,366	4

It is our contention that there is a definite relationship between the number of items reported and the number of employees injured. It is obvious that the number of reported items is an index of the interest of the employees in the work, and the fact that personal injuries have decreased as the number of reported items has increased speaks for itself. On the basis of injuries per million man-hours worked, the records show a reduction from 18.7 in 1925 to 1.8 in 1930. Of the four accidents that occurred in 1930, only one involved a trackman.

Discipline Is Next Step

It has been stated that it is possible to secure the cooperation of practically every man in safety work. There are, however, certain men that it is impossible to reach and who cannot comprehend the significance of the work. For this class of employees there is a means of correction that we have not as yet made use of, although we are about ready to do so as a last resource. I refer to discipline and the retirement of unsafe men from the service.

In addition to the matters referred to above, the regular order of business in the committee meetings comprises a review of the month's accident reports, which include all minor as well as all reportable injuries, a general discussion of safety work, etc., but the progress we have in mind is mainly attributable to the two items of business mentioned first.

After a time the meetings become uninteresting to a certain extent and we have resorted to a number of measures which are calculated to overcome this. Each supervisor is permitted to bring to the meeting a foreman or a man who has shown special interest in safety work. Occasionally a meeting is addressed by the safety representative of another corporation, or by someone demonstrating safety goggles, shoes or first aid kits. Once a year a general meeting is held which is attended by all foremen and certain other employees.

First-Aid Classes

We have also established first-aid classes wherein safety agents act as instructors. At the end of the course an examination is held by a practicing physician and when he passes the examination satisfactorily, the foreman is presented with a first-aid kit which is restocked as its contents are used. Certificates are issued to foremen who have had no personal injuries in their gangs for periods of one, two, three, five and ten years, and in presenting these we are careful to congratulate and encourage the recipients.

A statement of personal injuries is issued to each gang each month, describing the accidents, suggesting how they might have been avoided, and naming the foreman to whom each accident is chargeable. A roster of foremen has been issued showing their relative ratings according to the length of time they have worked without an accident. Out of 64 foremen we have 18 who have not had a personal injury in their gangs in 6 years, and we have one subdivision on which no accident has occurred in 3 years.

I have repeatedly used the word "individual" and have tried to stress its importance, for I am persuaded that, no matter what means are used or what methods are adopted as a basis or guide in safety efforts, to stop personal injuries the individual workman must be made to understand the purpose of the safety movement and to participate actively in the work.

Uses a Graphic Method in String Lining Curves*

By THOMAS WALKER
Roadmaster, Louisville & Nashville, Evansville, Ind.

FOR several years I have been using a semi-graphic method of adjusting curves by the string lining method which comprises a number of novel as well as advantageous features that should be a matter of practical interest to others concerned with the lining of curves. Fundamentally, the method consists of plotting the cumulative middle ordinates of the curve to a scale sufficiently large to admit of a reasonable degree of accuracy, and then of fitting in a revised curve. From this graph the sums of the differences between the original and revised ordinates are then obtained by scaling, to which values the string lining method is applied to obtain the half-throws for the revised curve. Thus it can be seen that the principal advantage of the method is that it eliminates a considerable amount of computation that would be necessary in determining the half-throws by the exclusively arithmetical method.

The method can best be illustrated by an explanation of the accompanying graph and table of calculations which comprise a record of the entire procedure followed in lining an actual curve. Column A of the table shows the station numbers at points where the middle ordinates were measured, the distance between stations being of course one-half of the chord length used, which may be any convenient length such as 62, 66, 78 or 100 ft. The original middle ordinates, which are obtained on the ground, are shown in Column B and may also be measured in any convenient unit, such as eighths of an inch or hundredths of a foot.

Column C gives the cumulative middle ordinates which are obtained from Column B by summing the middle ordinates as indicated by the arrows and which are used to plot the irregular unbroken line on the chart. This line affords a picture of the condition of the curve and enables its irregularities to be visualized. The next step

*The procedure described here is based on the mathematical principles outlined by Charles H. Bartlett in the series of articles entitled "The String Lining of Curves Made Easy" that were published in *Railway Engineering and Maintenance* in 1928. Moreover, it is assumed that the reader is familiar with the theory of the string lining method and for this reason no attempt is made in this article to explain the principles underlying the various steps. Whether or not others who employ the string lining method will agree that Mr. Walker's graphical method offers any advantage over the strictly arithmetical method, the method described here can be used readily as the preliminary step in selecting the revised curve, as further adjustments or refinements in the curve can be carried out subsequently by the arithmetical method, if desired.—Editor.

is to impose on the original line a revised curve as indicated by the broken line. In doing this the principal consideration is to adhere as closely as practicable to the existing curve and at the same time to eliminate the irregularities in order to obtain a smoothly riding curve. It should be borne in mind that, because of the desirability of obtaining a satisfactory curve that will require a minimum amount of throw, the closer the revised line is to the existing line the smaller will be the shift in the track.

Column D, which represents the sums of the errors or differences between the original and revised ordinates at each station, is obtained by scaling vertically the distance at each station between the two lines. When the original curve is the upper one, the values are positive and when it is below they are negative. A convenient way of remembering this is to compare the original line to the ground line on a construction profile and the revised line to the proposed grade line. In this way the "cuts," being in excess, are plus and the "fills," being deficient, are minus.

Table of Calculations

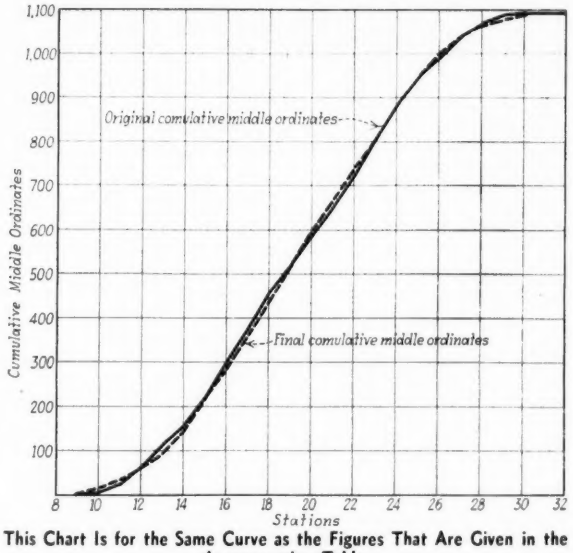
Stations	Original Middle Ordinates	Cumulative Orig. Middle Ordinates	Sums of Errors	Sums of Errors Corrected	Half-throws	Throws	Revised Ordinates	Errors
A	B	C	D	E	F	G		
9	0	0	−2	−2	0	0	2	−2
10	4	4	−9	−9	−2	−4	11	−7
11	20	24	−8	−8	−11	−22	19	+1
12	39	63	+1	+1	−19	−38	30	+9
13	50	113	+12	+12	−18	−36	39	+11
14	44	157	+4	+4	−6	−12	52	−8
15	63	220	0	0	−2	−4	67	−4
16	82	302	+7	+7	−2	−4	75	+7
17	75	377	+7	+7	+5	+10	75	0
18	81	458	+11	+11	+12	+24	77	+4
19	63	521	0	0	+23	+46	74	−11
20	69	590	−6	−6	+23	+46	75	−6
21	65	655	−13	−13	+17	+34	72	−7
22	70	725	−17	−17	+4	+8	74	−4
23	89	814	0	+1	−13	−26	71	+18
24	73	887	0	+1	−12	−24	73	0
25	63	950	0	+1	−11	−22	63	0
26	44	994	−5	−4	−10	−20	49	−5
27	44	1038	0	+1	−14	−28	39	+5
28	31	1069	+5	+6	−13	−26	26	+5
29	18	1087	+5	+6	−7	−14	18	0
30	6	1093	0	+1	−1	−2	11	+5
31	0	1093			0	0		
	Totals			−60	−59			
	"			+52	+59			

Note: The last two columns are not necessary in the application of this method, but were added to show that this method conforms to the arithmetical method.

It will be noted that in Column D the sum of the positive values is 52, while that of the negative values is 60. Since it is imperative that these values balance, an adjustment is applied to the last eight stations of Column D to give Column E. In making this adjustment a positive (+1) is added to each of the last eight stations, after which the positive and negative values each total 59. If the negative values had been in excess by 10 instead of 8, the adjustment could have been spread over 10 stations, or if necessary it could have been spread over the entire curve. In fact, an adjustment of even more than one point to each station is permissible. However, if the proposed curve is fitted in carefully with a view to balancing the "cuts" and "fills" visually, the adjustment is usually very simple.

The values in Column F, which comprise the half-throws at each station, are accumulated from Column E as indicated by the arrows. It should be noted that this column commences with zero at Station 9 and ends with zero at Station 31. In this connection, I might mention that in all of my curve work I commence my measurements with Station 10 in order to avoid the possibility of minus stations.

The values in Column G are merely twice those in Column F and represent the amount of shift necessary to secure the proper alinement. Negative values indicate that the shift is inward or toward the center of the curve while positive values indicate that it is outward or away from the center.



This Chart Is for the Same Curve as the Figures That Are Given in the Accompanying Table

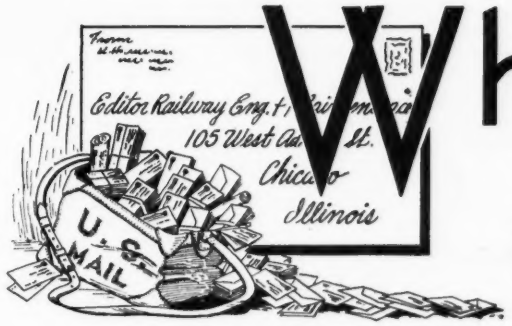
Note: Attention should be called to the fact that the above chart is drawn to a much reduced scale and if success is to follow the use of this method the ordinates should be plotted to a scale sufficiently large to assure the necessary accuracy in scaling the sums of errors.

The curved portions of the graph between Stations 8 and 15 and between Stations 24 and 31 represent the spirals at the ends of the curve. These curves are parabolas on the graph and must be drawn in as such in order to secure the proper spirals. Although this can be done with parabolic curves, I have secured entirely satisfactory results by plotting a series of parabolas or spirals on hard cross-section paper, so that the graph of the curve ordinates, which is plotted on transparent paper, can be superimposed over the parabolas and the proper one fitted in.

Attention should be called to the fact that on the graph there is a slight break in the proposed curve at Station 19. This introduces a slight compound in the curve but was done to reduce the amount of shift. However, so far as the riding of this curve is concerned, the compound is negligible and for all practical purposes the curve can be considered a simple one.

The most important part of this method is the laying out of the revised curve on the graph. This requires some skill and practice but can be accomplished with a little effort.

RAILWAY SALARIES—A bill providing that no railroad subject to the interstate commerce act shall charge to operating expenses compensation to any officer which, in the opinion of the Interstate Commerce Commission, is greater than is consistent with the economical management of such carrier, or in any case, is in excess of $50,000 a year, was introduced in the House on July 14 by Representative Garber, of Oklahoma.



What's the Answer?

Have you a question you would like to have someone answer?

Can you answer any of the questions listed in the box?

To Be Answered in October

1. How many men are required for the most efficient results with a surfacing gang, spacing and making a light renewal of ties, with a 4-tool tie-tamper outfit? With an 8-tool outfit? With a 12-tool outfit? Does the kind of ballast make any difference? How should the men be placed?

2. When renewing a high trestle and filling the ends to shorten it, should the piling be driven before or after the filling is completed? Why?

3. To what extent are motor-car set offs advisable? Where should they be located and at what intervals? How should they be constructed?

4. Is it practicable to connect a deep-well pump to a discharge line? Why? If so, under what conditions is it permissible to do so?

5. Can track bolts be kept too tight? If so, what effect does this have on track maintenance?

6. What information must be recorded on a stock list of second-hand I-beams and other structural shapes, as well as of complete bridge spans, to insure their ready use when opportunity affords? How should such a stock list be handled?

7. What effect, if any, does the character of ballast have on rail breakage?

8. Is it economical to apply storm windows to small stations in northern latitudes? If so, how should this be done and how should they be removed and stored during the summer?

Enginehouse Roofs

What are the relative advantages of wood sheathing and concrete or gypsum slabs for enginehouse roofs ?

Does Not Favor Gypsum Slabs

By A. T. HAWK

Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

While gypsum slabs will provide a fire-proof roof which should be reasonably free from condensation, I do not believe that they constitute a proper material for enginehouse construction, because there are always considerable steam and some locomotive gases in enginehouses. Moisture has a deteriorating effect on gypsum which has insufficient strength to form a roof slab when moisture gets into it. On the other hand, concrete also is fireproof, is of sufficient strength and is reasonably cheap as compared with other fire-proof materials.

One serious objection to concrete for this purpose is its tendency to sweat as a result of steam and other moisture in the atmosphere of the enginehouse. Unless it is well insulated, a concrete slab will condense the moisture from the air when the weather is cold and dripping will start very quickly. This trouble can be corrected very largely by placing the proper thickness of insulating board over the top of the slab and applying the roofing directly over the insulation. Another method is to construct the slabs with hollow tile to provide dead-air cells and thus provide the desired insulation.

Wood sheathing is most commonly used for roof decking in enginehouses. It is cheaper than either concrete or gypsum, repairs are easily made and it does not require the addition of special insulating material. The Rock Island has used 2-in. dressed and matched roof decking in its enginehouses for many years. The rafters are spaced to secure the full benefit of the practicable span for this thickness, thus allowing the rafters and purlins to have sufficient section to be slow burning. In general, no maintenance is required in roofs of this character, except the renailing of the sheathing boards when the roofing is renewed.

Where direct steaming or forced ventilation is installed there is no real need for roof insulation so that concrete or gypsum slabs can be used. In such houses, if they are used intensively, the air is warm and dry, the locomotives usually furnishing enought heat.

Wood Sheathing Is Most Commonly Used

By A. L. SPARKS

Architect, Missouri-Kansas-Texas, St. Louis, Mo.

Wood sheathing is most commonly employed in the roof construction for enginehouses because of its adaptability, its freedom from condensation and its low first cost. In thickly settled communities, however, its use is sometimes prohibited on the ground of the fire hazard. Reinforced concrete is used successfully where the climate is warm enough to eliminate condensation. In low temperatures moisture in the enginehouse condenses on the cold slab and this results in constant dripping of water. This has been overcome in some instances by the use of precast hollow slabs on concrete beams, which are covered with insulating boards or an insulating quilt placed under the roofing. Another type that has been used effectively in some localities is composed of concrete joists and hollow tile with a similar application of insulation.

Precast gypsum slabs laid on reinforced concrete beams are sometimes used as are also reinforced gypsum

slabs. They can be used only where there are no live loads to be imposed and they are not recommended for places where impact may occur. The typical engine-house contains several lines of piping, conduits, hangers, etc., which are suspended from the overhead framing or roof slab. Gypsum is too soft to permit it to support loads that are suspended by means of lag screws, as is often done from wood or concrete ceilings. Where all of these conditions can be predetermined, gypsum slabs may be economical because of their light weight.

I have had some experience with heavy wood sheathing laid on concrete beams, a type which may pass local ordinance requirements and which also eliminates condensation troubles. Where not restricted by ordinance, heavy mill-type wood construction, comprised of heavy wood beams spaced 4 to 5 ft. apart and covered with 3-in. sheathing, provides for slow burning, has considerable salvage value in case of change or abandonment and is easily remodeled.

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Slack Ties

When laying rail, should slack ties be shimmed or tamped to a bearing for the rail? Why? If the latter, should this be done by the rail gang, the section gang or some gang specially organized for this purpose ?

There Should Be Few Slack Ties

By R. H. GILKEY
Division Engineer, Central of Georgia, Savannah, Ga.

Track upon which rail is to be relaid should be given a light running surface and lined in advance of the rail renewal. This will eliminate slack ties, so that it will be necessary for the rail gang to care for only an occasional one, particularly at the joints in the old rail, and will relieve it of what sometimes becomes a real burden. In many instances this preparatory surfacing can be done by the section gang. If this is not practicable, a small special gang should be organized and placed in charge of a foreman who is capable of doing a first-class job of surfacing rapidly. The rail gang will then need only to lay the rail and load the released material. After the rail is laid, the track should be surfaced, the ties spaced if the standards of the road require, the bolts given a second tightening and the anti-creepers adjusted. This method will prevent surface-bent rail, and experience indicates definitely that a relatively small amount of preparatory work will pay large returns in longer service life for the rail.

Rail Should Have a Firm Bearing

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

This is an important matter that is often neglected in the hurry to get as much rail as possible laid in a given time. It is also one that it does not pay to neglect, since surface bending is a certain result, while line bending sometimes occurs. When the roadbed is frozen, shimming is the only means of providing a bearing on slack ties. Spiking should be omitted on slack ties until the shims are in place, since it is extremely difficult to drive the spikes straight where the ties do not contact with the base of the rail directly or through shims. If practicable, the section forces should do the shimming.

If the renewal is made in warm weather, the ties should be tamped, especial attention being given to the ties which supported the joints of the released rail. Here, too, the spiking should be omitted until the ties are brought to a bearing under the rail. If the spikes are not driven straight, the work of tamping is often seriously retarded. I prefer that the section forces do this work, but if this is impracticable, a small extra force should be organized and placed in charge of an experienced foreman who understands this kind of work.

Depends on Season When Rail Is Laid

By J. W. RIGGANS
Track Supervisor, Baltimore & Ohio, New Castle Junction, Pa.

If the rail is laid in winter when the track is frozen, the slack ties should be shimmed to provide a bearing for the rail. If it is laid in the spring or summer, the ties should be tamped to a bearing for the rail. In either case, this work should be done by the section gang. One or the other of these methods, depending on the season, is necessary to prevent damage to the new rail. If shimming is necessary, the shims should be removed and the ties tamped as soon as the weather permits.

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Anti-Creepers on Bridges

Is it permissible to install anti-creepers on open-deck trestles or steel bridges? If so, should there be any limitation on the length of the span or bridge on which they are applied? What is the most practicable method of holding the ties to which the anchors are applied ?

Depends on Purpose of Anchorage

By O. F. DALSTROM
Engineer of Bridges, Chicago & North Western, Chicago

Bridges should never be used as anchors for rail that is creeping on embankments. The anchorages of bridges are designed only to resist the longitudinal forces that result from braking and the working of the locomotives. It is always assumed that these forces originate in the moving loads on the structure, not in loads or forces beyond its ends.

Manifestly, it is impossible for a designer to know the magnitude of the forces that cause rails to creep on embankments, since they are never determined. Even if known, it would be improper to include them in the loads used in designing the structure, and thus add to its weight and cost, when, by the simple expedient of applying anti-creepers to the rail on the adjacent embankments, this creeping can be arrested. These statements are intended to apply where the rails are continuous between the bridge and the adjacent embankments.

Where effective rail-expansion joints are placed at the ends of bridges, thus breaking the continuity of the rail between the bridge and the adjacent embankments, the creeping of the rails on the roadbed does not produce forces that affect the bridge in any way. It then becomes necessary to anchor the rails on the bridge to prevent creeping toward either end.

On movable spans the continuity of the rails is interrupted and anchorage is essential to insure positive action of the end rails when opening or closing the bridge. The anchorage of the rails on the bridge under such conditions introduces longitudinal stresses into the bridge and its anchorages, but they are not excessive and can easily be provided for in the design.

Details of this anchorage can be very simple, consisting of two parts: (1) The ordinary form of anti-creepers for attachment to the rail and (2) angles riveted to the girders or stringers to prevent movement of the ties against which the anti-creepers press. To avoid possible crushing of the ties under the pressure of the anti-creepers, a steel bar ½ in. by 2 in. by 2 ft. may be attached to the tie at the point of contact with the anti-creeper. Such devices are justified in view of the longer and deeper ties which are more difficult to replace than those on the ordinary roadbed.

The angles may be standard sections 3½ in. by 3½ in. by ½ in. and long enough to be connected by two rivets to the girders or stringers. Where the traffic is all in one direction, as on double track, the creeping will all be in the direction in which the traffic moves. The anti-creepers will, therefore, all face in this direction while the angles will face in the opposite direction. If the creeping changes direction from time to time, as on single track, as a result of unbalanced traffic, similar anchorage should be provided for both directions.

No Limitation on Length of Span or Bridge

By W. H. KIRKBRIDE
Chief Engineer, Southern Pacific, San Francisco, Cal.

Anti-creepers should be applied to rails on open-deck trestles and steel bridges, provided a similar application has been made to the tracks adjacent to the structure. There should be no limitation on the length of the span or bridge on which they are applied. On steel bridges the anti-creepers should be applied against any ties that abut against floor beams and against others which are bolted to the steel stringers and guard timbers. On open-deck trestles they should be placed against ties that are bolted to the wood stringers and guard timbers, a sufficient number being used in all cases to avoid too great a strain on individual ties.

It is important that the rail be prevented from running on bridges; otherwise, damage to the track may occur—for instance, the proper expansion gap at the rail joints cannot be maintained, joint bars and bolts are subjected to unnecessary strains, ties become badly damaged and the rail is thrown out of line and surface.

Where anti-creepers are applied to bridges, it is desirable to use a larger number on the roadbed adjacent to the structure than would ordinarily be considered necessary, to reduce so far as possible, the creeping of the rail onto the structure.

Proof of the Pudding Is in the Eating

By P. G. LANG, JR.
Engineer of Bridges, Baltimore & Ohio, Baltimore, Md.

This question concerns only open-deck structures since the track on ballast-deck bridges differs in no respect from that on ordinary roadbed. It seems further that the discussion can be limited to fixed bridges, since it is obvious that the rail on both movable spans and approaches must be held securely in place. It might properly be limited to long-span structures, since for short spans any probable creepage can be overcome by applying anti-creepers on the approach roadbed.

In all cases where the prevention of rail creepage on bridges is under consideration, it seems advisable that an attempt first be made to prevent this creepage by anchoring the track on the approaches, regardless of the length of the structure. There seems to be no question that the anchoring of the track on a bridge sets up in the structure indeterminate stresses of some magnitude. For this reason, if proper rail conditions can be obtained without producing this effect, it is highly desirable to do so.

If anchorage is necessary, the solution of the problem is made in two steps: (1) By anchoring the rail to the ties and (2) by fastening the ties to the structure, the assumption being that the rail is anchored adequately on the approaches. Normally, any good type of commercial anti-creeper should give satisfactory results. In general, the second step can be accomplished by riveting small standard angles to the girders or stringers to provide a bearing for the anchor ties. It is not desirable to permit these ties to bear against the floor-beam flanges since inaccessible pockets are formed for the collection of dirt, which may accelerate corrosion.

The magnitude of the longitudinal forces set up as a result of this anchorage do not seem to be susceptible of accurate determination. Not infrequently, discussions occur in which it is maintained that they are sufficient to produce harmful effects in bridges. The best proof, however, is that of actual experience. For more than 20 years the Baltimore & Ohio has anchored the rail to the ties and the ties to the floor system of a steel bridge more than a mile long. For more than 10 years similar anchorage has been maintained on another structure approximately 1,500 ft. long. In neither case have any objectionable effects been observed.

Is Decidedly Opposed to Anchorage

By C. D. PURDON
Consulting Engineer, St. Louis, Mo.

My experience has made me decidedly opposed to the anchorage of track on bridges or trestles. One of the first cases of rail creepage to receive prominent notice was that on the Eads bridge at St. Louis, Mo. The movement here amounted to about 10 in. a day, and all attempts at anchorage failed. The rails sheared large bolts, kicked the track out of line and disturbed railway crossings. Later, expansion joints were installed, but they did not correct the trouble. Still later, the traffic was reversed on each track at regular intervals, and this practically overcame the effects of the creepage.

We had much trouble with rail creepage on the Mississippi River bridge of the Atchison, Topeka & Santa Fe at Ft. Madison, Iowa, which was replaced recently. This was corrected by anchoring the rails at both ends of the draw spans and using switch points on the adjoining fixed spans, using about 15 ft. of rail that was held by bridle rods but not spiked.

When the track was laid on the Thebes bridge over the Mississippi river, the flanges of the angle bars were sheared to prevent the catching of the spikes as the rail crept. Provision was made for expansion by means of a rabbet joint which was made by halving vertically about 15 in. of the ends of both rails at a joint. When the St. Louis Southwestern took its turn at maintaining the bridge, these joints needed renewal. I replaced them with expansion joints similar to those on the Eads bridge at about half the cost of renewing them in kind, retaining the sheared angle bars and allowing the rail to creep.

Later, while the Chicago & Eastern Illinois was maintaining the structure, measurements showed that from September 1, 1917 to July 1, 1918, or 303 days, the west rail on the southbound track ran 123 ft., this being equivalent to 0.406 ft. a day. From the latter date to December 1, 1920, or 884 days, the total creepage of this rail was 495 ft. at the rate of 0.56 ft. a day. This bridge is 2,750.5 ft. long. The rail at that time was the

A. S. C. E. 85-lb. section, the total weight of one line of rails, omitting the joint fastenings, being 77,945 lb. Since the coefficient of friction for metal on oak is about 0.5 or 0.6, the frictional resistance to this movement was 42,869 lb., or 5,146 lb. per sq. in. of the cross section of the rail.

On the trestle approach to the St. Louis Southwestern's White River bridge at Clarendon, Ark., the west rail moves north at the rate of 5 in. a week, while the east rail has a slight movement toward the south. An attempt at anchorage caused a rail to spring out of the track on two occasions. As a result, an expansion joint was installed and this has proved to be sufficient.

Assume that the track is anchored on a bridge consisting of several spans of, say, 300 ft. each. The extremes of expansion and contraction for each span will be about 3 in. For this reason, there will be a gap of 3 in. in the rail between adjacent spans at low winter temperatures or the rails will crowd under extreme summer heat.

Lining Track

When lining track, should a foreman face the sun or have it at his back? Why ?

Should Have the Sun at His Back

By CHARLES E. SANDOVAL

Section Foreman, Southern Pacific, Tubac, Ariz.

When lining long stretches of track, the foreman should study the line as far as he can see, standing erect with the sun at his back. It is difficult to line track properly when facing the sun, particularly in the clear atmosphere of the southwest, as the glare makes it impossible to see any distance. It is our practice to line only in the early morning when the rail is coolest and the glare of the sun is at a minimum.

Depends on Character of Lining

By M. H. MOSES

Section Foreman, Seaboard Air Line, Ragland, Ala.

When lining for a general line, a foreman should face the sun, since the bright running surface can be seen much farther and to better advantage than when the sun is at one's back. On the other hand, for detail lining, the sun should be at his back, because the bright reflecting surface of the rail is not uniform, varying from side to side of the rail head. For this reason, it is difficult, if not impossible, to give a finished line when facing the sun. If the sun is at one's back, the edges of the rail head stand out in sharper relief, making it relatively easy to correct the small irregularities in the line that remain from the general lining.

Eyes Will Eventually Be Affected Permanently

By L. G. BYRD

Bridge and Building Supervisor, Missouri Pacific, Wynne, Ark.

When practicable, one should always line with the sun at his back. He can do a much more uniform and finished job when the sun is not shining directly in his face. Many foremen are unable to qualify in their later years because of defective vision. In my opinion, many of them are paying the penalty of failure to take ordinary precautions to protect their eyes, but have continued the harmful practice of lining toward the sun, which they learned to follow when the rail sections were smaller. When facing the sun, particularly near midday in the summer or while snow is on the ground, the reflection is thrown directly into the eyes. Continuous lining under these conditions tires the eyes so that one is unable to distinguish slight or short variations in the line. He also becomes unable to see distinctly for any great distance when lining long swings.

Reflection Tends to Confuse Vision

By PETER MARIMEN

Section Foreman, New York, Chicago & St. Louis, South Gary, Ind.

It is my experience, having tried both methods, that a much better line can be obtained when the sun is at one's back. When the sun's rays are reflected from the rail head, they tend to deceive the eye and make it difficult to judge the magnitude of small irregularities in the line. This is particularly true of the larger rail sections since the reflecting surface is relatively wide and the outline of the reflection is somewhat indistinct.

Reflection Tires Eyes and Affects Vision

By R. ROSSI

Yard Foreman, Alton, Glenn, Ill.

I am decidedly of the opinion that one should not face the sun when lining track. The reflection makes it difficult to see distinctly and tires the eyes quickly. If necessary for him to turn with his back to the sun, the liner is unable to see the rails clearly for some time and even then must strain his eyes to do so. Furthermore, the time required to do lining with the sun at one's back is appreciably less, thus releasing the labor for other tasks. It is my observation that a foreman who habitually lines toward the sun eventually loses his ability to line at all.

Oiling Angle Bars

What is the advantage, if any, of applying oil to the outside of angle bars in track? What kind of oil is most suitable? How should it be applied? When should it be done ?

Affords Protection Against Corrosion

By A. N. REECE

Chief Engineer, Kansas City Southern, Kansas City, Mo.

The practice of oiling the outside of angle bars in the track is a simple and inexpensive method of protecting them and also the bolts, nuts and nutlocks against corrosion. Joint bars cost approximately one-tenth as much as the rail. Oil applied to their surface protects them from the corrosive forces of the weather and from the even more destructive effects of brine drippings from refrigerator cars. Added years of life obtained by oiling mean money savings in replacement costs. Oiling also lubricates the bolts and spring washers, thus permitting easier tightening of bolts. Without this protection, water and brine frequently reach the threads, corroding them and preventing proper bolt tightening. In addition to extending the service life of main-line track fastenings, oiling should also make possible the salvaging of a greater percentage of the material removed in the process of relaying, than could be recovered for further service if no lubrication were used.

An oil with good preservative and lubrication properties should be used, which can be obtained at reasonable prices. Road oil distillate gives very satisfactory results, as do special oils produced for such purposes by practically all of the larger refining companies.

Generally the most economical and satisfactory method of application is by the use of a force spray. This method is quicker, less expensive and gives better penetration than hand application. However, oil may be applied satisfactorily by the regular section forces, using buckets with brushes or mops. Personally, I favor the spray method, making a continuous application of oil to the joint bars, rail and tie plates, since the benefit, in my opinion, is well worth while. The added cost of oil is offset by the greater labor cost of the hand method, although it is possible to spray only the individual joints if it should be desired to save the expense of spraying the rail, tie plates and spike heads.

Angle bars should be oiled at least once a year, preferably at the beginning of hot weather, and oiling should be followed by bolt tightening.

Heavy Asphalt-Base Oils Give Best Results

By FLOYD C. GAGE

Section Foreman, Michigan Central, Dexter, Mich.

The only advantage in oiling joint fastenings is to prevent corrosion. In my opinion, the results outweigh the cost and effort of making the application. If properly done, this protection extends to the tie plates as well. My experience indicates that a cheap grade of heavy oil having an asphalt base is most suitable. I have used fuel oil with good results when the other was not available. It should always be recognized that the cost will outweigh the benefits if the application is made too expensive. The best time to make the application is in the early spring when the days are warm and dry, after the bolts are tightened for the season. A 4-in. paint brush is best for this purpose.

Increases Salvage Value of Fastenings

By J. W. RIGGANS

Track Supervisor, Baltimore & Ohio, New Castle Junction, Pa.

One of the important advantages of applying oil to the outside of angle bars is that it preserves both the angle bars and the bolts. In relaying rail where the joint fastenings have been kept oiled, it is possible to salvage at least 75 per cent of the bolts, practically all of which would have been destroyed if they had not been given this protection. The cheapest oil for this use is reclaimed engine oil mixed with graphite in the proportion of 1 lb. of graphite to 15 gal. of oil. Graphite costs about two cents a pound, while the reclaimed oil has no value except for this purpose. Application should be made during the months of October and April. It can be made with either a brush or a spray, the latter method being much quicker and cheaper.

Would Also Oil Inside at Ends

By ROBERT WHITE

Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

In my opinion, the oiling of angle bars prolongs their life and that of the bolts far more than enough to offset the cost of the applications. To afford complete protection, the oiling should be done both inside and out at the time of application. During later application of the oil to the outer surface, the inner surface should be similarly treated as far back from the ends as it is possible to reach without loosening the bolts.

Many foremen prefer to use a large brush, such as a whitewash brush, for applying the oil. I have found it more satisfactory to use a regulation 4-in. paint brush. This enables one to reach between the rail and the joint at the ends as well as under the bolt heads and nuts.

Any cheap grade of heavy road oil is suitable. Light and reclaimed oils are virtually valueless since they do not have sufficient body or are not durable. Oils that give the best results have a high asphalt content, so that lubricating oils of any kind do not offer suitable protection.

One important requisite of maximum protection against corrosion, particularly if a large amount of refrigerator traffic passes over the line, is that the oil should be applied at regular intervals. These applications should be made in November and again in April. Winter bolt tightening removes a certain amount of the oil, while salt drippings are usually most severe during the hot summer months.

Center-Bound Track

Does track become center bound more quickly on curves than on tangents? Why? How can the trouble be corrected or minimized ?

Is Not Sure That It Does

By H. T. LIVINGSTON

Division Engineer, Chicago, Rock Island & Pacific, Little Rock, Ark.

I am not at all certain that track becomes center bound more quickly on curves than on tangents. In my opinion it would be difficult to state the relation in this respect between tangent and curve. Several elements combine to produce center-bound track, including the type of ballast, the ballast section, the width and height of the subgrade, axle loads, speed of trains, density of traffic, and the frequency with which the track is given a general surface.

In general, I am inclined to believe that center-bound track is less likely to be found on curves than on tangents, because roadmasters and section foreman alike are quite likely to place any excess ballast that is available on the curves. Furthermore, for obvious reasons, curves receive more frequent surfacing and lining than tangents, which tend to prevent the development of center-bound track.

Many Important Considerations

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Any track carrying a reasonably heavy traffic will become center bound if it is not given proper attention. Ballast should be kept clean, tamping should not be done at the center of the ties, the track should be given a general lift at relatively frequent intervals, good drainage should be maintained and the ballast shoulder should be properly dressed. If these items are not given constant attention center-bound track may be expected with absolute certainty.

Again, the roadbed must be maintained to the proper height and width to support the ballast shoulder on both curves and tangent. A narrow subgrade also makes center-bound track a certainty, regardless of the kind or amount of ballast. Insufficient ballast is a common

cause of this trouble, while the method of dressing the shoulder may have a definite influence on the tendency to become center bound. Center-bound track is found less frequently on curves than on tangents, principally because they are given more attention, since foremen realize the greater necessity of keeping smooth-riding track on curves.

Where a dense traffic is carried, the tendency of the track to become center-bound is more marked than on lighter traffic lines, so that more consideration should be given to keeping a wide roadbed and a full ballast section. Any weakness in the provisions for drainage should be overcome on any class of track, however.

No, Because Curves Are Better Maintained

By F. FIFIELD
Engineer Maintenance of Way, Boston & Maine, Boston, Mass.

Center-bound track results from the settlement of the ties into the roadbed or the heaving of the bed under action of frost until the unyielding part of the support is at the middle of the tie. Center-bound track is a sure indication that surfacing out of face is needed. Such track may appear to be in good line and surface, yet it cannot be maintained in smooth-riding condition.

Assuming the same ballast and subgrade conditions and equal attention to surfacing, track will become center bound more quickly on tangents than on curves, provided the proper superelevation is maintained. As a rule, curves are better maintained than tangents. When a curve becomes center bound, it is generally because of settlement of the low rail, and track must settle more on curves than on tangent to produce the center-bound condition, provided the ties have been properly tamped, that is, not more than 12 or 15 in. inside the rail.

To correct the trouble, center-bound track should be raised out of face enough to lift the ties above the ballast bed so that there will be no bearing at their centers. To minimize the rate of approach to this condition, good drainage and ballast are necessary, and the ties should not be tamped more than 12 to 15 in. inside the rail. Track that is lifted about 1½ to 2 in. once in 2 to 4 years and properly tamped, leaving about 6 in. at the center of the tie untamped, will not become center bound, provided the ballast is of fair quality, the subgrade is to standard and the drainage is satisfactory.

Various Factors Cause This Trouble

By H. R. CLARKE
Engineer Maintenance of Way, Chicago, Burlington & Quincy, Chicago

Other factors than alinement have a greater effect in producing or retarding the growth of center-bound track. If these factors are present, the track will tend to become center bound regardless of whether it is on tangent or curve. Among them are narrow embankments, scanty ballast, failure to surface the track out of face at suitable intervals and improper tamping, either in connection with a general surface or in ordinary maintenance.

Subgrade of the proper width to support the ballast and a ballast section wide enough to support the track are necessary to prevent center-bound track. Probably careless or improper tamping, that is, tamping too solidly at the center as compared with the ends of the ties, has a greater effect in producing center bound track than most of the other factors, since it is often found in good ballast of proper section which is supported on a wide roadbed. The widening and raising of the subgrade or the addition of ballast is seldom within the control of the section forces, but proper tamping is decidedly within their control.

Since the adoption of ties 8 ft. 6 in. long, there has been less tendency for the track to become center bound. Just how much this has helped it is difficult to say, because, in general, the change from the 8-ft. tie has been gradual and in connection with ordinary renewals. The general opinion of roadmasters and section foremen is definite on this point, however, while they also say that both line and surface are more easily maintained under heavy traffic.

Center-bound track was much more common on "dirt" track than it is on ballasted track, since the form of dressing used on unballasted track makes this condition almost unavoidable. If the ballast section is scanty, the tendency of the track to become center bound can be minimized and the line can be more easily maintained by filling the cribs at the ends of the ties, even if it is necessary to leave the center of the track skeletonized. When track becomes center bound, the only way to correct the trouble is to give it a general surface, making sure that the tamping is done properly. At this time, narrow or low subgrades should be raised and widened and a sufficient amount of ballast applied to give a standard ballast section.

Deep-Well Pumps

What are the relative advantages of reciprocating and centrifugal pumps for deep-well pumping? What are the limitations, if any, of each type ?

Turbine Is Replacing Reciprocating Pump

By C. R. KNOWLES
Superintendent Water Service, Illinois Central, Chicago

In considering the relative advantages of the different types of deep-well pumping equipment, it is well to bear in mind that the advantages of any type for a particular installation will depend largely, if not entirely, on the conditions under which it is to be used. For this reason, the conditions surrounding the installation should be known and analyzed to insure that a type is selected which will insure maximum efficiency in pumping.

For many years the reciprocating pump was used exclusively for pumping water from deep wells, except that to a limited extent the air lift was employed. Within recent years, however, the turbine type of the centrifugal pump has been developed to a point where it is being received with considerable favor by water-service men and at present is being used widely.

So far as railway water supply is concerned, the field of the reciprocating deep-well pump is confined almost exclusively to wells of small capacity, say 200 g. p. m. or less. The advantage of the reciprocating pump, as compared with the turbine, lies in the higher efficiency, with which it operates.

This is because it is a positive-displacement pump and is, therefore, more flexible over a wider range of yields and heads. The efficiency of this type of pump remains substantially the same under fluctuating heads, while the efficiency of the turbine is affected by any marked change from the head for which it was designed.

Difficulties in transmitting the power from the power head or motor are common to both types of pumps. In one case the power must be transmitted to a revolving

shaft, in the other to reciprocating rods. The advantages in this instance are in favor of the revolving shaft, particularly for depths greater than 150 or 200 ft., beyond which the weight of the rods becomes an important factor in determining the size of the power head for a reciprocating pump.

An important advantage of the centrifugal, or turbine, pump is that it is able to deliver a much greater volume of water from a well of a given diameter. Recent developments in the design of turbines have resulted in a material increase in their efficiency, the curve being considerably flattened over a relatively wide range of pumping levels. This is one of the primary reasons why they are replacing reciprocating pumps in many installations. This does not apply, however, to wells with a meager reserve of water, where the ability to operate the reciprocating pump at low speeds adapts it particularly for wells of low capacity.

Every Case Requires Special Study

By R. L. HOLMES
Engineer of Water Supply, Texas & Pacific, Dallas, Tex.

Every deep-well installation presents individual features and to obtain best results should be given special study. The volume of water available, the amount to be pumped, the pumping lift and the character of the water, all play an important part in the selection of the type of pumping equipment best suited to the conditions.

Up to a few years ago, dependence was placed almost entirely on the deep-well reciprocating pump, but with the advent of the turbine and its continued improvement, this type is fast replacing the reciprocating type. There are conditions, however, where the use of the latter is still warranted, especially where the volume of water is limited and the setting is deep.

Until about two years ago I placed the limit of the pumping level for turbines at 250 ft. Since then I have made installations of these pumps at depths of 400 and 450 ft. with good results. There are improvements now under way in this type which, in my opinion, will practically remove the limit and enable them to be used at practically any depth encountered.

Reinforcing Old Footings

When necessary to extend the footing of an old pier or abutment, what precautions should be taken in doing the work ?

Underpinning Is a Delicate Operation

By A. R. KETTERSON
Assistant Engineer of Bridges, Canadian Pacific, Montreal, Que.

In extending an old footing, the procedure will depend in large measure upon the magnitude of the work involved, the length and type of span, the height of the substructure unit, the general traffic conditions, the character of the soil and the amount of water to be encountered. An answer to this question covers, therefore, a wide range of conditions. There are, however, certain general considerations that will apply to all cases.

If the spans are short and do not add appreciably to the total dead weight, it may not be necessary, but it is usually preferable, to support them during the work. If the spans are long, it is advisable to support them, not only to reduce the load but to eliminate the vibration.

Since the purpose of the extension is to spread the load over a greater area, provision must be made to insure that its quota of the load will be transferred effectively from the shaft, so that the extension will usually be made to the toe of an abutment but entirely around the perimeter of a pier. This brings in the consideration of the advisability of shoring the shaft laterally as a precaution against tilting during the excavation. Again, to insure still further that the load will be properly transmitted to the added masonry, it is generally advisable to carry the new footing somewhat deeper and underneath the body of the existing unit. In other words, work of this character generally requires that the underpinning shall extend well under the shaft.

Underpinning a heavy mass of masonry is a delicate operation, which must be carried out in such a manner as not to disturb the consolidation of the soil underneath the body of the pier or abutment. The best method of doing this is to excavate short sections and complete the placing of the concrete before excavating for the adjoining section. In most cases several sections at reasonable distances apart can be constructed simultaneously.

As a further insurance that the load will be transmitted properly to the extension, it is usually advisable to build a jacket around the body of the shaft at least to the ground line, cutting deep horizontal recesses in the old masonry to key the jacket into it. If the shaft is constructed of undressed stone masonry, this surface may be sufficient to provide the necessary key.

This Work Requires Extreme Care

By Engineer of Bridges

Extending the footing of an old pier or abutment is a delicate operation at best, and becomes doubly so if the old masonry is of stone, particularly if the old structure is to be underpinned as it should be. The precautions that must be taken depend in some measure on local conditions and whether the old masonry rests on piles.

It is of the most urgent importance that the compacted soil under the old masonry be not disturbed beyond that immediately necessary for the removal of the excavation. In some, but not all, instances this will require as a preliminary the driving of wooden sheeting in close contact with the old footing. The excavation under the footing and body of the pier or abutment should be made in relatively small sections, and the concrete for that section should be deposited and allowed to harden before excavation is started on the adjoining sections. If, as is quite likely, reinforcement is required, it will be necessary to introduce this in short pieces which should lap well into each of the adjoining sections, this being provided for in the design. This method also requires that the sheeting be cut out in front of the section under construction.

Where old stone masonry is being underpinned, extreme care must be exercised to insure that none of the stones become dislodged during the excavation or the following operations of cutting off the piles, if this is necessary, the placing of the reinforcement and the depositing of the concrete. If the pier or abutment is large, several sections, well apart, can be excavated and filled simultaneously. If the work is of sufficient magnitude, the gang can be divided into separate units for excavation, placing the reinforcement and concreting, each moving to a new section as soon as its part of any section is completed. There are few classes of work that require more alertness on the part of the foreman to insure the safety of the substructure unit as well as that of the men engaged on the project.

What Our Readers Think

Torch or Track Chisel?

Leeds, Ala.

To the Editor:

I do not wish to appear critical of the excellent discussions on the cutting of rails with the oxy-acetylene torch, which were published on pages 457 and 458 of the July issue, but in view of the economy of this method of cutting I desire to cite my own experience.

Over a period of years I have not observed a single instance where rails that have been cut with a torch have broken or suffered other forms of failure which could be traced to the effect of the use of the gas flame.

It is my observation that if the man who does the cutting is skillful in the use of the torch and does the cutting in the proper manner, no damage to the rail will occur. It is admitted that breaks often follow the drilling of the rail with the oxy-acetylene flame, but the danger of this can be minimized by first drilling a small hole in the rail, say, with a bonding drill, and then reaming it out with the torch. This method is much faster than the use of the ordinary track drill and will be satisfactory for rail that is to be used in yards or in other slow-speed tracks. I would not recommend it, however, for rail that is to be used in high-speed tracks.

In my opinion the gas torch should be placed high in the list of modern devices which conserve time and money in railway maintenance. It is a particularly satisfactory tool at the present time when every railway officer is racking his brain for new ways to spread a dollar over a larger amount of work. Under ordinary conditions its use is in keeping with the progress that is being made throughout the maintenance field.

Some improvement is still possible and should be made in the art of gaging and adjusting the flame for cutting metals. I am quite sure that this can be perfected to the point where a T-rail can be cut with practically no disturbance of the metal on either of the cut surfaces. It is obvious, however, that no matter how precisely the flame can be or is adjusted, the results of the cutting will depend in large measure upon the skill of the operator and the care with which he does the work.

J. Morgan,
Supervisor, Central of Georgia.

New Book

Wood Preservers' Proceedings

PROCEEDINGS of the American Wood-Preservers' Association for 1932. 470 pages, illustrated, 8½ in. by 6 in. Bound in cloth. Published by the Association, 1427 Eye Street N. W., Washington, D. C.

This volume contains the complete report of the twenty-eighth annual convention of the American Wood-Preservers' Association, which was held at St. Louis, Mo., on January 26-28, 1932. The subject matter includes papers and reports relating to the science and practice of the preservative treatment of wood and on the service records and behavior of treated wood in practical use. Included among the material is a paper by J. S. McBride on the Thirty-Two Years' Experience with Treated Ties on the Chicago & Eastern Illinois; one by F. R. Judd on Creosoted Pile Foundations for Railway Building Structures; and another by R. A. Van Ness on the Treatment of Bridge Timber and Piling on the Atchison, Topeka & Santa Fe Railway System. In addition, the volume contains the Annual Statistics on the Quantities of Wood Treated and Preservatives Used in the United States.

Slotting Rails with Precision

A NEW device, known as a slotting guide, for use with the cross grinder which it manufactures and which was described on page 200 of the March issue, is being introduced by the Nordberg Manufacturing Company, Milwaukee, Wis. The slotting guide is not intended to be an integral part of the cross grinder, but an accessory to permit a more uniform and precise slotting of the rail ends than is practicable by hand.

This device, which weighs only 30 lb., consists of a roller-mounted carriage constructed of special steel tubing, all joints of which are welded, which is mounted on a frame that sets over and is clamped to the rail. The frame is so designed that it can be fitted to the rail to permit the operator to work either inside or outside of the track. Adjustments are also provided so that it will fit rails of any section or height.

How the Slotting Guide Is Used

In use, the frame is placed over the rail to bring the grinding wheel in line with the rail ends. A lever is then pulled to clamp the frame to the rail and the roller-mounted carriage is moved back and forth laterally until the slot is ground to the desired depth. The wheel can be set to any desired position and at any angle, and it is claimed that through the use of the guide the grinding can be done to any depth without danger of the wheel being pinched and broken; that the slot can be ground with vertical sides or beveled to any angle, with the assurance that the cuts in succeeding joints will be identical; and that this can be done at the rate of one joint a minute. By means of the flexible shaft of the grinder, the joints of both rails can be reached with the grinder set on either rail.

News of the Month . . .

Western Lines May Create "Umpire"

The railways in Western territory have under consideration the adoption of a plan to elect an officer representing all of them who will serve as an arbiter or umpire to pass upon controversies arising from questions of competition in service, rate-making, etc. If the proposed office is created, election of the man to fill it will be made by the executive committee of the Western Association of Railway Executives.

Expect Lower Carloadings in Third Quarter

The shippers of the country, through estimates submitted to the shippers' regional advisory boards, anticipate that carload shipments of the 29 principal commodities in the third quarter of 1932 will be 21.1 per cent under the actual loadings for the same period in 1931. All boards anticipate a decrease in traffic compared with the same quarter of 1931, the percentages of decrease ranging from 8.1 in the Southwest district to 35 in the Great Lakes district.

Number of Employees Sinks Lower

The number of employees on Class I railroads of the United States as of the middle of May, totaled 1,081,596, which was a reduction of 5,066 from the total of the previous month and a reduction of 255,735 or 19.12 per cent, below the corresponding month of 1931. The number of maintenance of way employees showed the greatest percentage reduction, being 23.21 per cent below the corresponding month of last year.

R. F. C. Advances $145,653,540 to Roads

As of June 30, the Reconstruction Finance Corporation had authorized loans amounting to $213,882,724 to 38 railroads, and had actually advanced $145,653,540 of that amount, according to its monthly report submitted to Congress. Of this amount $6,166,679 has been repaid. Up to June 30, the Interstate Commerce Commission has approved loans of approximately $235,000,000, on applications from 98 roads aggregating over $400,000,000.

Cent-a-Mile Rate Draws Business

More than 25,000 persons took advantage of the cent-a-mile rate offered by the Southern on June 18, in commemoration of the 38th anniversary of its incorporation. The low-fare tickets, with a return limit of eight days, were available for journeys between all points on the Southern and also to certain destinations on connecting lines. Accompanying concessions were also made by the Pullman Company.

Drawn by low excursion rates of various types, 7,500 passengers were handled by the St. Louis-San Francisco during the week-end of Sunday, July 17, thereby establishing a record for the year on this road. Many roads reported excellent passenger business over Independence Day, and in certain cases the business handled exceeded that of last year.

U. P. Employees Care for 3,892 Families

A total of 3,892 families or cases were cared for during the period of 7½ months ending with May 15, by the Union Pacific Railroad Employees' Relief Fund, made possible by employees voluntary contributions of $150,737 for the relief of their unemployed fellow workers. In addition, a total of 158 sick and injured hospital cases of furloughed employees and their families were treated by the Union Pacific hospital department, while 1,498 sick and injured cases not requiring hospital attention were also treated.

Production of Joint Bars and Tie Plates in 1931

The production of steel angle bars in the United States in 1931, according to statistics issued by the American Iron & Steel Institute, amounted to 100,922 gross tons, compared with 116,686 tons in 1930, while steel fish plates and other rail joints aggregated 16,305 gross tons in 1931 and 19,080 tons in 1930. The output of steel tie plates amounted to 234,291 gross tons in 1931, compared with 399,872 tons in 1930, and the production of iron tie plates was 18,154 gross tons in 1931, compared with 27,574 tons in 1930.

I. C. C. Approves Four-System Plan

The Interstate Commerce Commission on July 21 handed down a decision approving the plan for consolidating all eastern railroads, except those in New England, into four great systems to be built around the Pennsylvania, the Chesapeake & Ohio-Nickel Plate, the New York Central and the Baltimore & Ohio. The original plan of the commission, which was published in 1929, provided for five systems in eastern territory, the fifth system to be built around the Wabash and the Seaboard Air Line, but since both of these lines are now in receivership the commission acceded to the request of the major lines for a four-system plan. It is expected that the final consummation of the plan will require several years because of the many obstacles yet to be overcome.

Propose Aid for Destitute Families

A plan for the creation of a federal corporation to finance unemployed heads of households in amounts not exceeding $500 was approved by the Railway Labor Executive's Association, at a meeting at Cleveland, Ohio, on June 23. According to the plan, the corporation would be similar to the Reconstruction Finance Corporation and would be designed to provide emergency loans for the purchase of the necessities of life by unemployed heads of households, who are ordinarily capable of self support.

Loans by Railroad Credit Corporation

The Railroad Credit Corporation, which was formed to administer the income from the freight rate increase authorized early in the year by the Interstate Commission, in its monthly report to the latter body on July 1, reported that loans either actually made or authorized to railroads to meet their fixed interest obligations totaled $29,589,563 on that date. Of that amount, $15,938,690 represents loans actually made, leaving a balance of $13,650,873, to which the corporation is committed.

Collection and Delivery in New York

Optional collection and delivery service for carload non-perishable freight moving from and to points in New York City will be instituted on September 15 by railroads serving this vicinity. This action is being taken after two and one-half years of more or less continuous agitation from shipping interests and studies by railroad committees. Charges in addition to the rail rate will be assessed for the pick-up and delivery service, and will range from six cents per 100 lb. for shipments of 36,000 lb. and over, to 20 cents per 100 lb. for shipments of between 14,000 and 10,000 lb.

Five Months Net Equals 1.11 Per Cent

The net operating income of Class I railroads of the United States for the first five months of 1932 amounted to $99,495,673, which was at the annual rate of return of 1.11 per cent on their property investment, as compared with a net operating income of $189,386,370, or 2.12 per cent, in the corresponding period of last year. Operating revenues for the first five months totaled $1,355,204,742, as against $1,817,752,767 for the same period in 1931, a decrease of 25.4 per cent, while operating expenses amounted to $1,081,276,419, a decrease of 24.7 per cent. In the first four months of this year the Class I railroads had a net deficit of $76,489,492, after the payment of rentals and interest, whereas for the same four months of last year the roads had a net income of $959,610 after the payment of rentals and interest.

Association News

Bridge and Building Association

Owing to the absence of a quorum at a meeting of the Executive committee called at Chicago on July 9, no action has yet been taken officially with reference to the 1932 convention. A letter ballot is now being taken of members of the Executive committee on a suggestion that the meeting be called off and it is expected that official announcement will be made to this effect shortly. A formal meeting of the Executive committee is now scheduled to be held in September.

Tie Producers' Association

Members of the National Association of Railroad Tie Producers met in Chicago on July 16, at which time a new constitution was adopted, changing the name of the organization to the Railway Tie Association and broadening and more clearly defining its objectives. At this meeting action was also taken looking to the initiation of measures for the collection and dissemination of statistics showing the number of ties in the yards of the producers and the railways, which statistics, it is believed, will be an effective aid in controlling both abnormal shortages and surpluses.

International Railway Maintenance Club

The next meeting of the International Railway Maintenance Club will be held on Thursday, August 11, at the General Brock Hotel, Niagara Falls, Ont., Canada. Following luncheon, which will be served at 12:30 p. m., E.S.T., and the regular business meeting of the club, two papers will be presented—one by W. H. Newman, signal supervisor, New York Central, on the relation of the signal department to the track department, and the second by a representative of the Armco Culvert Manufacturers Association on the use of culvert pipe in track drainage.

American Railway Engineering Association

As this is the season of the year when committee work is largely conducted through the agency of the subcommittees, only two committees of the association held meetings during the month of July. The Committee on Masonry held a two-day meeting at Chicago beginning on July 14, with an attendance of 20; and the Committee on Iron and Steel Structures met at Detroit, Mich., on July 21 and 22, with 9 members present. The Committee on Rules and Organization will meet in Chicago on August 19.

The Proceedings for 1932, embodying a full report of the convention held in March, are now in the hands of the printer. Evidence that activities of the association were not seriously curtailed during the last year is afforded by the fact that the Proceedings will contain only 14 pages less than those for 1931.

The Roadmasters' Association

At a meeting of the Executive committee at Chicago on July 9, it was decided to abandon the 1932 convention. This action was taken after consultation with railway executives and in recognition of the conditions now confronting the railways. The salaries of the secretary and treasurer were reduced to a nominal basis and arrangements made to hold other expenses to the minimum. By action of the Executive committee, the dues of all members who are now in good standing will be remitted for the year 1933. Bulletins will be issued to members quarterly as heretofore to advise them of the status of the organization and to maintain their contact with it.

Freight Traffic in May

Freight traffic handled by the Class I railroads in May amounted to 19,870,195,000 net ton-miles, according to reports compiled by the Bureau of Railway Economies. Compared with May, 1931, this was a reduction of 33.8 per cent, and it was a reduction of 45.7 per cent under May, 1930. In the Eastern district, freight traffic handled in May was a reduction of 31.9 per cent compared with the same month in 1931, while the Southern district reported a decrease of 37.6 per cent. The Western district reported a decrease of 35.1 per cent.

Employees of S. P. of Mexico Strike

Employees of the Southern Pacific of Mexico went on strike on June 27 as a protest against a proposed 10 per cent reduction in wages. For a time operations of the company were at almost a complete standstill and efforts to have the Federal Board of Arbitration and Conciliation of Mexico declare the strike illegal failed. Following the failure of the Federal Board of Arbitration and Conciliation and the workers to reach an agreement, President Ortiz Rubio on July 20 directed the Ministry of Communications to take over the management of the system and begin running trains.

Santa Fe Has Most Powerful Rail Car

The Atchison, Topeka & Santa Fe has recently placed in service the largest and most powerful car of the gas-electric type yet constructed, in an effort to develop the further possibilities of power rail cars for improved passenger train service. This car, of practically all-steel construction, is about 90 ft. long, weighs 245,000 lb., and develops a maximum of 900 hp., sufficient to haul four heavy passenger cars as trailers. The car is suitable for low-speed, heavy-duty operation and, at the same time, is capable of speeds up to 80 m.p.h. where the loads are light and traffic conditions permit.

Personal Mention

General

Sir Henry Thornton, chairman of the board of directors and president of the Canadian National, who began his railway career in the engineering department of the Pennsylvania, resigned effective August 1. Sir Henry has had a long and distinguished railway career, including service with railways in both this country and England. He was born on November 6, 1871, at Logansport, Ind., and was educated at the University of Pennsylvania and Syracuse University. Immediately after leaving school in 1894, he entered the service of the Pennsylvania as a draftsman in the chief engineer's office, serving successively until 1911 as assistant engineer of construction on the Marietta division, topographer on various surveys, assistant engineer on the engineering corps, division engineer and division superintendent. At that time he was made general superintendent of the Long Island, which position he held until 1914, when he went to England to become general manager of the Great Eastern Railway (now the London & North Eastern). During the war, Sir Henry held various high positions in the English army in which he had charge of the transportation of troops by rail in France, rendering such distinguished service that he was honored in various ways by four nations. In 1922, he was elected chairman of the board of directors and president of the Canadian National, with headquarters at Montreal, Que., which position he held until his recent resignation.

Sir Henry Thornton

R. W. Simpson, assistant general manager of the Atlantic region of the Canadian National, and formerly assistant chief engineer of the Intercolonial (now part of the C. N. R.), who retired on June 1, as noted in the July issue of *Railway Engineering and Maintenance,* was born in Scotland but soon went to Canada. After graduating from the Royal Military College at Kingston, Ont., in civil

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engineering, he entered railroad service with the Intercolonial on July 22, 1889, in the chief engineer's office, where he remained until August, 1902, when he was appointed assistant chief engineer. In June, 1909, he became advisory engineer to the board of management. In November, 1912, he was appointed advisory engineer to the board of management and general superintendent and in September of the next year he was appointed assistant to the general manager; he also held the position of general fuel and tie agent. In December, 1918, Mr. Simpson was appointed assistant to the general superintendent and in June, 1922, he was promoted to acting general superintendent. Upon the co-ordination of all government-owned lines into the Canadian National in March, 1923, Mr. Simpson was appointed assistant to the general manager of the Atlantic region, and in April, 1924, he was advanced to assistant general manager of that region, which position he held until his retirement.

R. W. Simpson

Engineering

L. C. Frohman, principal assistant engineer of the Florida East Coast, with headquarters at St. Augustine, Fla., has been appointed to the newly created position of chief engineer.

Perry Topping has been appointed division engineer of the Northern division of the St. Louis-San Francisco, with headquarters at Ft. Scott, Kan., to succeed **R. P. Cummins,** who has resigned.

J. F. Earl, division engineer of the Portage division of the Canadian Pacific, with headquarters at Winnipeg, Man., has been promoted to assistant superintendent of part of the Moose Jaw division, with headquarters at Moose Jaw, Sask.

W. O. Houston, division engineer of the Middle division of the Michigan Central, with headquarters at Jackson, Mich., has had his jurisdiction extended over the West division, and **J. D. Elder,** division engineer of the latter division, with headquarters at Niles, Mich., has been appointed roadmaster as noted elsewhere in these columns. **John Evans,** division engineer of the Detroit division and the Detroit terminals, with headquarters at Detroit, Mich., has had his jurisdiction extended to include the Toledo division. As noted elsewhere in these columns, **J. A. Snyder,** division engineer of the latter division, has been appointed roadmaster, with headquarters as before at Detroit.

E. J. Bayer, division engineer of the Chicago division of the Cleveland, Cincinati, Chicago & St. Louis, with headquarters at Indianapolis, Ind., has been transferred to the Cairo division, with headquarters at Danville, Ill.

L. J. Hughes, district engineer maintenance of way of the First district of the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, has been appointed division engineer of the Nebraska-Colorado division, with headquarters at Fairbury, Neb., succeeding **F. Kirk,** whose appointment as master carpenter is noted elsewhere in these columns. As announced in the July isue of *Railway Engineering and Maintenance*, the First and Second districts of the Rock Island, which comprise the entire system, were consolidated on July 1, with headquarters at Kansas City, Mo., and **F. T. Beckett,** district engineer maintenance of way of the Second district, with headquarters at El Reno, Okla., was made engineer maintenance of way of the system. **T. P. Warren,** office engineer of the First district, with headquarters at Des Moines, Iowa, has been transferred to Kansas City, with jurisdiction over the system, while **A. H. Sturdevant,** office engineer on the Second district, at El Reno, has been appointed master carpenter as noted elsewhere in these columns.

The positions of district engineer on the Chicago, Burlington & Quincy were abolished, effective July 15, and all work previously handled under the jurisdiction of the district engineers on the Eastern and Central districts was placed under the jurisdiction of **C. L. Persons,** assistant chief engineer at Chicago, while **F. T. Darrow,** assistant chief engineer at Lincoln, Neb., has had his jurisdiction extended to include the duties of the district engineer of the Western district. **R. W. Willis,** district engineer of the Eastern district, with headquarters at Chicago, has been appointed division engineer of the Galesburg and Beardstown divisions, with headquarters at Galesburg, Ill. He replaces **W. G. Boon,** who has been transferred to Burlington, Iowa, where the position of division engineer is newly created. **E. H. Peck,** district engineer of the Central district, with headquarters at Burlington, Iowa, has been appointed division engineer of the St. Joseph division, with headquarters at St. Joseph, Mo., succeeding **R. H. Johnston,** who has been appointed an instrumentman at the same point. **G. F. Hamilton,** district engineer of the Western district, with headquarters at Wymore, Neb., has been appointed division engineer of the Wymore division, with headquarters at the same point, succeeding **C. W. Charleson,** who has been assigned to other duties.

Track

H. O. Kelley has been appointed supervisor of track on the Wabash, with headquarters at Forrest, Ill., succeeding **S. H. Bergstrom.**

The position of assistant supervisor of track on the Southern at Birmingham, Ala., which has been held by **P. Blackford,** has been abolished.

Harold J. Fielding, a track foreman on the Union Pacific, has been promoted to roadmaster, with headquarters at Cheyenne, Wyo. **G. E. Hammock** has been appointed roadmaster, with headquarters at Salina, Kan.

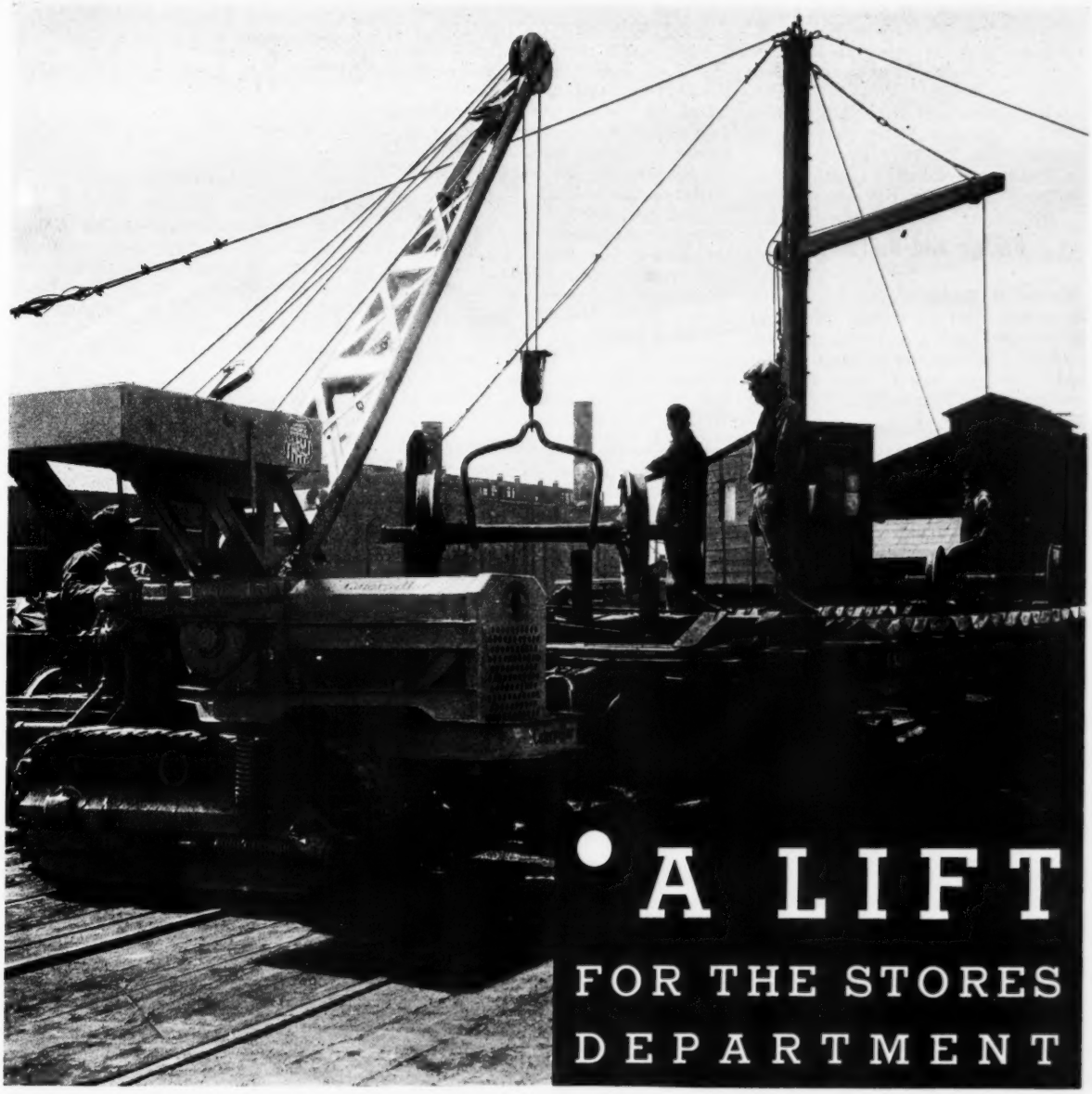
J. D. Elder, division engineer of the West division of the Michigan Central, with headquarters at Niles, Mich., has been appointed roadmaster, with the same headquarters, succeeding **G. W. Grafford,** who has been assigned to other duties. **J. A. Snyder,** division engineer of the Detroit division and of the Detroit terminals, with headquarters at Detroit, Mich., has been appointed roadmaster at that point, succeeding **L. A. Clayman,** who is temporarily disabled.

F. E. Box, roadmaster on the Gulf, Colorado & Santa Fe, with headquarters at Lometa, Tex., has been transferred to Temple, Tex., to succeed **Michael Clarke,** whose death was noted in the July issue. **E. V. Tooley,** roadmaster, with headquarters at Pauls Valley, Okla., has been transferred to San Augustine, Tex., where he replaces **J. M. Soward.** Mr. Soward has been transferred to Silsbee, Tex., where he relieves **F. M. Lewis,** who has been granted a leave of absence.

The track inspector system has recently been established on the Missouri division of the Chicago, Rock Island & Pacific, necessitating a rearrangement of the four roadmasters on this division, including the appointment of one of them as a track inspector, and the division of his territory among the other three. **P. Knowles,** roadmaster at Carlisle, Iowa, has had his headquarters moved to Trenton, Mo., while **T. W. Brown,** roadmaster at Centerville, Iowa, has moved his headquarters to Des Moines, Iowa. **E. Sullivan** retains his headquarters as roadmaster at Washington, Iowa. **Paul Buser,** roadmaster at Trenton, has been appointed track inspector.

A. M. Kennedy, assistant on the engineer corps of the Conemaugh division of the Pennsylvania, has been appointed to assistant supervisor on the Buffalo division, succeeding **A. Fulkerson,** who has been transferred to the Conemaugh division, where he replaces **C. F. Neu,** who has been transferred to the Eastern division. Mr. Neu succeeds **W. P. Geiser,** who has been promoted to supervisor on the Panhandle division, with headquarters at Wheeling, W. Va., where he replaces **J. Foley,** deceased.

E. R. Burchette, assistant supervisor of track on the Toledo division, has been promoted to supervisor of track on the Cincinnati division, with headquarters at Richmond, Ind., succeeding **J. B. Hill,** who has been transferred to the Indian-



A LIFT FOR THE STORES DEPARTMENT

UP GOES a set of flat car wheels — unloaded from the "Caterpillar"-pulled trailer at the rate of one a minute. Down go the stores department's costs at the rate of several dollars an hour. By the former method, the cost was 67 cents per pair of wheels — by this method, only 20 cents per pair! The switch engine stays in the roundhouse — with bumper or drawbar the "Caterpillar" speedily spots a string of cars, loaded or empty. This one "Caterpillar," equipped with a Hughes-Keenan Crane, replaces other tractors and a stationary crane. And this same unit does a wide variety of supply-handling jobs, at the lift of the crank! . . . Pushing, pulling, lifting — powering pumps, compressors, hoists — mobile, all-weather "Caterpillar" Tractors are already shouldering big responsibilities, helping balance thrifty budgets.

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FIFTEEN	$1100	THIRTY-FIVE	$2400
TWENTY	$1450	FIFTY	$3675
TWENTY-FIVE	$1900	SIXTY-FIVE	$4350
DIESEL	$6500		

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apolis division, with headquarters at Indianapolis, Ind. Mr. Hill replaces **J. F. McKinney,** who has been transferred to the St. Louis division, with headquarters at Terre Haute, Ind., where he replaces **B. J. Boyle,** who has retired. **C. B. Brown,** assistant supervisor of track on the St. Louis division, has been transferred to the Indianapolis division, with headquarters at Louisville, Ky.

Bridge and Building

Samuel H. Busby, a bridge and building carpenter on the Omaha division of the Missouri Pacific, and formerly a supervisor of bridges and buildings on this road, retired on June 12, after 42 years service with the Missouri Pacific.

F. Kirk, division engineer of the Nebraska-Colorado division of the Chicago, Rock Island & Pacific, with headquarters at Fairbury, Neb., has been appointed master carpenter of the El Paso-Amarillo division, with headquarters at Dalhart, Tex., where he succeeds **A. E. Causey,** who has been assigned to other duties. **A. H. Sturdevant,** office engineer on the Second district, with headquarters at El Reno, Okla., has been appointed master carpenter on the Panhandle-Indian Territory division, with headquarters at Shawnee, Okla., where he replaces **A. Courtney.**

Following the consolidation of the First and Second districts, **H. H. Alfrey,** chief scale inspector of the Second district at El Reno, has been transferred to Kansas City, Mo., with jurisdiction over the combined districts. **C. G. Stoody,** chief scale inspector of the First district, at Des Moines, Iowa, has been assigned to other duties.

Water Service

L. W. Craus, supervisor of water service of the First district of the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, has been transferred to Kansas City, Mo., with jurisdiction over the entire system, following the consolidation of the First and Second districts. **F. A. Luce,** supervisor of water supply of the Second district, with headquarters at El Reno, Okla., has been assigned to other duties.

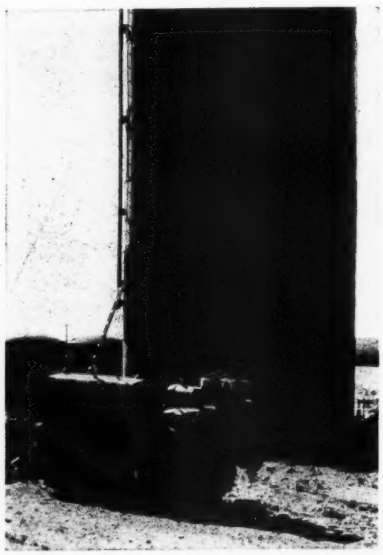
Obituary

A. Mara, supervisor on the Louisville & Nashville, with headquarters at Whitesburg, Ky., died on July 16, at Falmouth, Ky.

J. D. Pitt, supervisor of track on the Louisville & Nashville, with headquarters at Humboldt, Tenn., died on May 23 after 41 years service with the L. & N.

B. O. Johnson, retired assistant to the operating vice-president of the Northern Pacific, who formerly served as a roadmaster on this road and on the Atchison, Topeka & Santa Fe, died on June 27, at St. Paul, Minn. Mr. Johnson was born on May 25, 1878, at Winchester, Mass., and was graduated from Worcester Polytechnic Institute in 1900. His first railway service was with the Northern Pacific as a trackman at Minneapolis, Minn., in 1900. A year later he was transferred to the engineering department and in 1903 he was promoted to roadmaster. Two years later Mr. Johnson left the Northern Pacific to become a roadmaster on the Atchison, Topeka & Santa Fe, but returned to the former road in 1906 as a trainmaster. Later Mr. Johnson was advanced to division superintendent and served in this and various other positions until 1917, when he entered the United States army. Returning to the Northern Pacific in 1923, he was appointed assistant to the vice-president in charge of operations, which position he held until his retirement on December 1, 1931.

J. B. Carothers, superintendent of the Ohio division of the Baltimore & Ohio, who served as chief engineer of the B. & O. for a short period in 1910, died on April 22. Mr. Carothers, who was 69 years of age, took up railway service on June 10, 1895, as an assistant engineer on the B. & O. at Cincinnati, Ohio. A year later he was promoted to division engineer and after serving in this capacity on various divisions he was further advanced to superintendent of the Ohio division, serving in this position on several divisions until the spring of 1910, when he acted as chief engineer for a short time. Later Mr. Carothers served as superintendent of the Philadelphia division, as special engineer at Cincinnati, and as assistant general manager at the same point. On October 1, 1921, Mr. Carothers was appointed superintendent of the Indiana division. Two years later he was transferred to the Ohio division, with headquarters at Chillicothe, where he was located at the time of his death.



A Caterpillar Model Twenty Tractor Equipped with a Dewey Air Compressor Seen in Operation on the Atchison, Topeka & Santa Fe Supplying Air for Demolishing the Concrete Bottom of the Water Tank in the Background

Supply Trade News

General

The Nordberg Manufacturing Company, Milwaukee, Wis., has moved its New York office from 51 East 42nd street to the Lincoln building, 60 East 42nd street, and has moved its Los Angeles, Cal., office from 1462 Stanley avenue to the Subway Terminal building at 417 South Hill street.

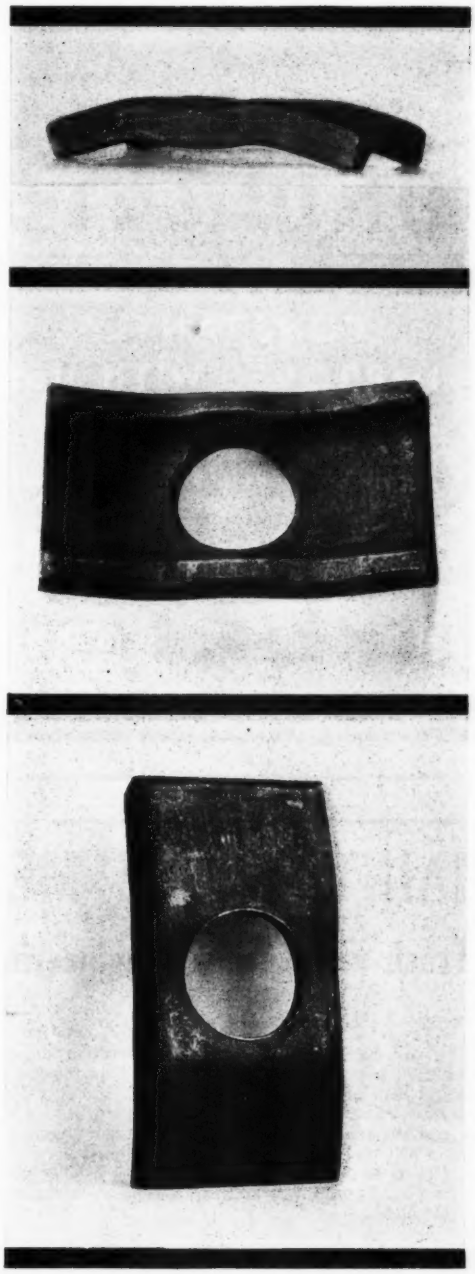
The Worthington Pump & Machinery Corporation, New York, will transfer and consolidate its designing, engineering and manufacturing activities formerly carried on at its Cincinnati, Ohio, works, with those of its Buffalo, N. Y., manufacturing plant, and the necessary members of the Cincinnati works organization are being transferred to Buffalo.

Personal

J. E. Buckingham, western manager of the Railroad division of the **Worthington Pump & Machinery Corporation,** with headquarters at Chicago, has resumed his duties after a leave of absence of two months.

James R. Mills, manager of sales of the **Carnegie Steel Company,** with headquarters at Cleveland, Ohio, has been appointed manager of sales of the New York district, with headquarters at New York, succeeding **Charles G. Cluff,** who retired on July 1 after more than half a century in the steel business. **Francis C. Hardie,** assistant manager of sales of the Illinois Steel Company, at Chicago, has been promoted to manager of sales of the Carnegie Steel Company at Cleveland, to succeed Mr. Mills.

E. E. Russell Tratman, associate editor of the Engineering News-Record specializing in railroad matters, who is known to many railroad engineers for his book Railway Track and Maintenance and for his other extensive writings dealing with the theory and practice of railroad engineering, retired on July 1. Mr. Tratman had been connected with the editorial staff of the Engineering News-Record and one of its predecessors, the Engineering News, for 46 years, of which the last 35 were in the Chicago office. Born in Bristol, England, he came to this country in 1884 and served for two years with the Long Island Railroad before entering upon his journalistic career as a member of the staff of the Engineering News. As a special agent for the United States Department of Agriculture, Mr. Tratman, in 1894, prepared detailed reports on metal and wood ties and on the preservation of wood ties. In 1897, he published the first edition of Railway Track and Trackwork of which the name was changed to Railway Track and Maintenance with the 1926 edition.



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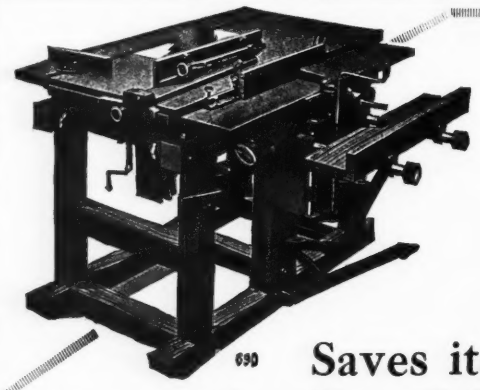

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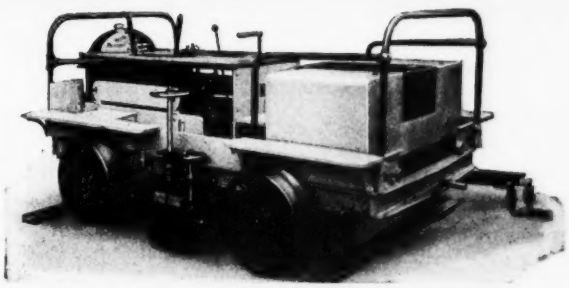

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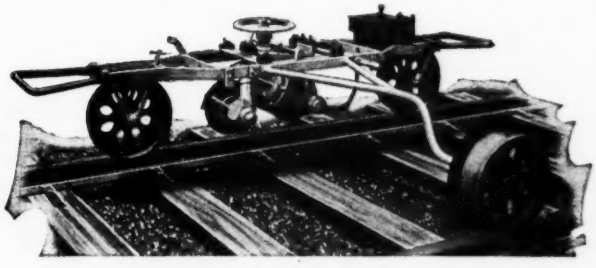

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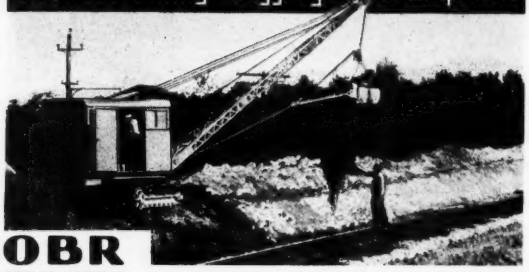

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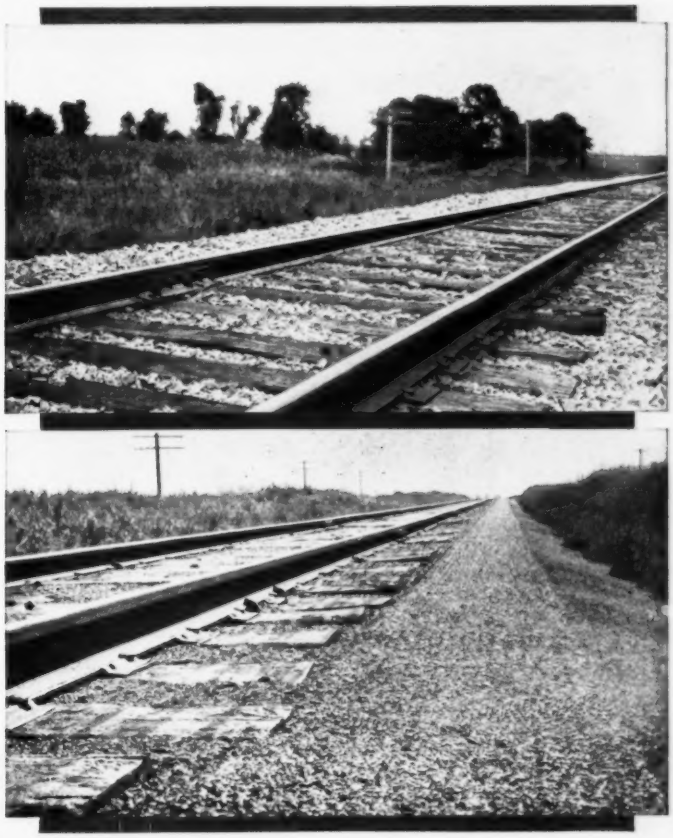

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